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**Machine Gunners'**  
**Pocket Book**

## Machine Gunners' Pocket Book.

**T**HIS Pocket Book has been produced with the intention of providing a Machine Gun Officer with technical and other information for reference and use in the field, in as condensed a form as possible.

Every Officer who is supplied with this book is requested to fill in the card at the beginning of the book, and forward it to the Chief Instructor, Machine Gun School, M.G.T.C., England, where it will be filed.

Any alteration, amendment, or addition will be forwarded to every Officer in possession of this book, as it becomes ready for issue, *provided that the address card has been received and that all changes of address are notified.* For some of these books no cards have been received, and consequently it has not been possible to send additions, etc., to the possessor.

Any suggested improvement or addition that is considered necessary from experience gained on active service should be forwarded to the Chief Instructor, Machine Gun School, M.G.T.C., England.

These suggestions will be collated, carefully considered, and published as an amendment, if deemed necessary.



# CHAPTER I.—FIRE DIRECTION.

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## CHAPTER I., SECTION 1.

### GENERAL.

#### PARA. 1.—ANGLE OF SIGHT.

In indirect fire (except when using graticules) it is necessary to find the angle of quadrant elevation. This is done by combining the angle of sight to the target with the tangent elevation for the range. By the use of Tables 3 (A) and 3 (B), or by the graph given as an appendix, all such calculations may be done away with, and the necessary angle of quadrant elevation can be obtained directly without determining the angle of sight.

It is possible, however, that there may arise an occasion when the angle of sight is required, and the following is the best formula to use:—

$$\frac{\text{V.I.}}{\text{H.E.}} \times 3400 = \text{angle of sight in MINUTES,}$$

V.I. and H.E. being in the *same* unit (*e.g.*, both in metres, or both in yards).

#### NOTES.

- (1). If target is above gun, V.I. is positive, and *vice-versa*.
- (2). The error in the resultant angle of sight obtained by the formula given above is less than one-quarter as large as that introduced by most other formulæ.
- (3). When the target is visible, the angle of sight may be found directly, without calculation, either by the use of an angle of sight instrument, or by means of the gun and spirit level. In the latter case proceed as follows:—
  - (i.) Lay the gun on the target, with sights at zero.
  - (ii.) Level the gun, and read off the elevation dial, the angle through which the gun has been moved. This will give the required angle of sight—positive if the gun has been *depressed* when levelling, and negative if the gun has been *elevated* when levelling.

(An alternative way to measure the angle is by the use of the tangent sight, but the above is the quicker method.)

PARA. 2.—RULES FOR CONVERSION OF YARDS TO METRES.

It will be observed that all linear dimensions in the tables, sheets, and formulæ in the Pocket Book are given uniformly in yards, with the exception of the graph, which shows the vertical interval in yards and metres.

The two following simple rules can be used for converting metres to yards, or yards to metres :—

RULE I.—To convert metres to yards add  $\frac{1}{10}$ .

RULE II.—To convert yards to metres subtract  $\frac{1}{10}$ .

EXAMPLE.—RULE I.

Convert 133 metres to yards.

Answer  $133 + 13.3 = 146.3$  yards.

EXAMPLE.—RULE II.

Convert 1840 yards to metres.

Answer  $1840 - 184 = 1656$  metres.

NOTES.

- (i.) Rules I. and II. are so simple that they can be applied more quickly than a conversion table.
- (ii.) Rule I. is accurate to within  $\frac{1}{4}$  per cent.  
Rule II.        „        „         $1\frac{1}{4}$  per cent.

PARA. 3.—RESECTION, AND LOCATION OF POSITIONS ON THE MAP.

Of the various methods for locating, on the map, one's position on the ground, the three following are those chiefly used at the present date (October, 1917).

1. *By Resection.*

Resection is :—

- (1). Useless when the map itself is inaccurate.
- (2). Unnecessary when the map is accurate in detail, and the position to be located is near any object which it is possible to identify, both on map and ground.
- (3). Necessary when the map is accurate in detail, but when the position to be located is *not* near any object which can be identified both on map and ground.

To locate a point by resection.

- (a) Select two points on the ground which are marked on the map, and on which compass bearings can be taken. (They should be as near  $90^\circ$  apart as possible, so as to get good intersection).

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(b) Using a prismatic compass (or its equivalent) determine the magnetic bearings of these points: convert to grid bearings and then, on the map, lay out back bearings from the corresponding points on the map. (Compass error must be allowed for: see Section I, Para. 7).

(c) These back bearings will intersect at a point which, if the compass and map are accurate, will be the required position.

NOTE. (1) Three points may be used instead of two, as a check upon accuracy. In this case, if the three back bearings do not all pass through one point on the map, they will form a triangle.

If this triangle is LARGE, either the compass is inaccurate and should be tested (see Section 1, Para. 7), or the work is inaccurate and should be repeated, or the map is inaccurate, in which case nothing can be done.

If the triangle is SMALL (sides less than  $\frac{1}{4}$ "), two cases may arise:—

(i.) Where the small triangle falls *inside* the triangle formed by joining the three points to which bearings were taken.

In this case, the actual position may be taken as at the centre of the small triangle.

(ii.) Where the small triangle falls *outside* the triangle formed by joining the three points to which bearings were taken.

In this case the procedure is more difficult, and the point can only be found by estimation, using the following rules:—

The point will be outside the small triangle: it will be either to the right or to the left of all the rays, looking towards the three points to which bearings were taken: and it will be nearest to that side which is formed by the shortest ray (back-bearing).

Its exact position is determined by the condition that its respective distances from the rays (back-bearings) must be proportional to the lengths of the rays themselves.

Whenever three points are being used, try and get them approximately  $120^\circ$  apart, so as to get condition (i.) above and avoid the difficult case (ii).



## 2. By Compass and Rangefinder.

It may happen that one object only can be identified both on the map and on the ground. In this case, a position may be determined by taking the bearing of that object, and the range to it. (The rangefinder *must* be accurate and the range over 250 yards for a Barr and Stroud instrument.)

On the map, lay out a back bearing from the object, and measure back a distance to the map scale, corresponding to the range found. This will locate the position.

## 3. By Aerial Photographs.

It frequently occurs that no objects remain on the ground, on which bearings can be taken. In this case resort must be had to aerial photographs. Generally speaking, only vertical photographs, free from distortion, should be used for locating positions for indirect fire.

(a) If the required position is on some ground feature, etc., which appears on the photograph, and also on the map, all that is necessary is to locate the ground feature, etc., on the map, and put in the required position on it by inspection of its position on the photo—e.g., the corner of a wood, or well-marked field, etc.

(b) If the required position is *not* on any recognisable spot, its position on the photo may be transferred to the map by the following method:—

(i.) On the photo, select 4 points, easily identified on the map, which are so situated that the lines joining them intersect on or near to the particular point which it is desired to fix.

(ii.) On the map, draw lines joining these 4 points: the intersection of these lines will give the true position on the map of the corresponding point of intersection on the photo.

(iii.) If, on the photo, this intersection is *on* the particular point, the position of the latter can be found on the map at once: if the intersection is *near* to it, measure the distance and direction of the point from the intersection on the photo, and thus plot it on the map.

#### PARA. 4.—THE SPIRIT LEVEL.

The spirit level forms the basis of all indirect fire, except when graticules can be used (see Section 4). The level itself cannot be adjusted, but its correctness can easily be checked by comparing it with a clinometer known to be correct, or by testing on a surface known to be level. The error (if any) when determined, should be marked on the instrument.

When applying the level (but not during reading), the gun should be gently *tapped* (not pressed), with the hand on the top of the barrel casing so as to shake the level slightly and assist the bubble in taking up its true position.

#### PARA. 5.—THE CLINOMETER.

The clinometer is the instrument chiefly employed for putting elevation or depression on the gun, when firing by indirect means.

It consists of two machined seatings at right angles to each other, joined together by a metal frame, part of which forms an arc of a circle graduated in degrees.

Pivoted at the centre of the arc, is a radial arm graduated in minutes from 0 to 60, and carrying a sliding bed fitted with a spirit level.

The radial arm is moveable, and can be set to any desired reading of degrees up to 44, by means of a spring catch on which a pointer is marked.

The spirit level bed is clamped by means of a milled headed screw and can be set to any required reading in minutes by means of a pointer marked on the bed.

Instructions for use are contained in Section 4, Paras. 10 and 13, of this Chapter.

Instructions for testing are given in Section 1, Para. 8 of this Chapter.

#### PARA. 6.—THE DIRECTION AND ELEVATION DIALS.

The direction and elevation dials should be kept permanently attached to the cone head and elevating wheel respectively. Care should be taken of the dials, both to prevent actual deformation, due to rough usage, and also, so far as possible, to prevent the scales becoming obliterated.



### DIRECTION DIAL.

There are two patterns now in use :—

- (1) A dial graduated from  $0^{\circ}$  to  $180^{\circ}$  in both directions, and not rotatable.
- (2) A dial graduated from  $0^{\circ}$  to  $180^{\circ}$  in both directions, and rotatable.

Pattern No. 2 is to be preferred.

The pointer should be attached to the right hand side of the crosshead. The screws which attach the dial to the cone head should be kept tightly screwed up. All ranks should be practised in the use of the dial, as except in the case of No. 2 type, it is easy to make mistakes. For instance, if, when the gun was laid on the reference object, the first pattern read 170 and it was desired to swing  $30^{\circ}$  right, the final and correct reading might be either 160 or 140 according to which of the two lines marked 170 on the dial was originally opposite the pointer. For the method of using the direction dial, see Section 4.

### ELEVATION DIAL.

As one complete turn of the elevating wheel elevates or depresses the gun through an angle of  $4^{\circ}$ , the dial is divided into 4, each division giving  $1^{\circ}$ . Each degree is sub-divided into four parts, giving angles of  $15'$  and each of these is further sub-divided into three, giving angles of  $5'$ .

The screws serving to unite the halves of the elevation dial, should be kept tightly screwed up, and the clamping screws which lock the dial to the elevating wheel should be properly looked after, and occasionally oiled.

When it is desired to set the dial to zero, while maintaining the laying of the gun, the hand should be placed underneath the dial and engaged in the spokes of the elevating wheel, to prevent it from turning. The clamping screws are then loosened, the dial rotated until the pointer indicates zero, and the clamping screws tightened up.

For the use of the elevation dial, see Section 4.



#### PARA. 7.—HOW TO TEST A COMPASS.

The compass used by the machine gun officer must be a good prismatic instrument, or its equivalent in accuracy. The best compasses, however, are liable to possess errors, and it is important that these errors should be known.

The error of any particular compass (*i.e.*, the difference which the compass reading is above or below the actual magnetic bearing of any given direction) is not necessarily constant for all parts of the scale. For example, for actual magnetic bearings of  $0^{\circ}$ ,  $90^{\circ}$ ,  $180^{\circ}$  and  $270^{\circ}$ , the compass might read  $359^{\circ}$ ,  $90^{\circ}$ ,  $180.5^{\circ}$  and  $269.5^{\circ}$  respectively. Thus the corrections to be applied to the compass readings would be  $+1^{\circ}$ ,  $0^{\circ} - 0.5^{\circ}$  and  $+0.5^{\circ}$  respectively.

Compasses are tested by most good optical instrument firms for about 3/6, including postage, and the compass is returned with a slip showing the corrections to be applied at the four cardinal points.

For reference, the following addresses are given :—  
Messrs. Negretti & Zambra, Ltd., 38, Holborn Viaduct,  
London, E.C.1.

Ross Limited, 111, New Bond Street, London, W.1.

A method of testing a compass on the ground with the aid of a map is given below. This will give the variation of any particular compass with reference to the grid north on the map. The procedure is as follows :—

1. Decide on a point on the ground, the position of which you can mark with certainty on the map.

2. Select an object which can be seen from the above point, and which is marked on the map. This object should be as far away from the above point as possible as errors in obtaining angles are easily made if it is too close.

3. On the map, draw a line through the point, parallel to the grid north lines. With a protractor, measure the grid bearing of the object from this point.

4. On the ground, take the compass bearing of the object from the selected point. (It is best to take the mean of three readings, to 10 minutes if possible).

5. The difference between the mean of the compass readings, and the grid bearing found in para. 3, will be the variation of your compass with reference to the grid lines of the particular map you have used, the locality in which you are situated, and that part of the compass scale which you have used.

NOTES.—In order to ascertain the variation of your compass at different parts of the scale, repeat the above procedure on different objects.

No steel or iron should be in the vicinity of the compass when it is being used (*e.g.*, gun or tripod, rifle, revolver, steel rails, etc.). In the case of the gun, it is advisable to remove it to a distance of about three yards. Steel helmets make a perceptible difference, in some cases as much as 1°. Some wrist watches affect the readings. Compasses should not be placed in close proximity to other compasses.

The grid north lines on a map are not necessarily parallel to the sides of the map, or to the true north line. Bearings, however, are usually given as "Grid Bearings" and not as "True Bearings," so that they may be measured directly from the grid north lines.

If you want to ascertain the *actual* magnetic variation of your compass from *true* north (as distinct from *grid* north) by the above method, instead of drawing the line (*vide* para 3, above) through the point parallel to grid north, you must draw it parallel to *true* north, and measure the true bearing of the object.

The true north meridian is sometimes shown on the margin of the map.

#### PARA. 8.—HOW TO TEST A CLINOMETER.

There are three methods of testing a clinometer.

1. On a known level surface. The R.A. have a special surface for testing clinometers, and if access to this can be arranged, it is the best method of testing.

2. Against a clinometer or spirit level known to be correct.

3. By testing against itself. With the clinometer set to read zero, place it on the gun and adjust the elevating wheel until the bubble is central. Reverse the clinometer, and if the bubble is still central, the instrument is in adjustment.

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If the bubble has moved towards the graduated arc, it is reading high; and *vice-versa*.

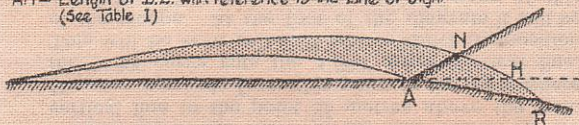
To ascertain the amount of the error, adjust the clinometer until the bubble is central, and note the reading. The error of the instrument will be half this reading.

NOTE.—The Mark III. clinometer is adjustable: the Mark IV. is not. In the latter case, the error, if any, will have to be noted, and allowance made for it when using the instrument.

#### PARA. 9.—NOTES ON THE INFLUENCE OF SLOPE OF GROUND UPON THE BEATEN ZONE.

A "near" slope, as shown at AN in the diagram below will have the effect of shortening the beaten zone on the ground: a reverse slope, as shown at AR, lengthens it.

AH = Length of B.Z. with reference to the Line of Sight  
(See Table 1)



As an approximate guide to the amount of reduction or increase, Table 8 has been compiled by graphical methods. The method of use is shown best by two examples.

(a) Range 2000 yards: gradient of near slope (such as AN), on which shots are falling, is found from the map to be 1 in 20: the 90% B.Z. at 2000 yards is 130 yards long: from the table, the factor in the vertical column under "2000," opposite "near slope  $\frac{1}{20}$ " is 0.78. The B.Z. on the slope will be  $130 \times 0.78 =$  say, 100 yards.

(b) Range 2400 yards: gradient of reverse slope (such as AR),  $\frac{1}{12}$ : the E.B.Z. at 2400 yards is 86 yards long: from the table the factor is found to be 1.42: the E.B.Z. on the reverse slope will be  $86 \times 1.42 = 122$  yards long.

#### PARA. 10.—NOTES ON THE GRAPH FOR CALCULATING QUADRANT ELEVATION AND CLEARANCES.

This has been designed as a supplementary method of calculating angles of quadrant elevation and clearances



above our own troops or obstacles. It is particularly adapted for use with maps contoured in metres. The method of use is explained at the foot of the graph.

Example of use:—

(a) To find the angle of quadrant elevation—Suppose the gun to be on a 105 metre contour, and the target to be on a 120 metre contour (*i.e.*, 15 metres above the gun) at a range of 2,500 yards.

Take the 2,500 range and follow up the vertical line to a point 15 metres above the gun level. It will be found that the  $7^{\circ} 50'$  curve cuts this point. This will be the correct angle of quadrant elevation to put on the gun.

(b) To find the clearance over our own troops—Suppose that our own troops are on the 190 metre contour (*i.e.*, 85 metres above the gun) at a range of 1,000 yards.

Take the range 1,000 yards, and follow up the vertical line to the point 85 metres above the gun. Measure upwards from this point to the point where the  $7^{\circ} 50'$  curve cuts the 1,000 range vertical line. This will be seen to be 23 metres above the position of the troops. At the foot of the diagram it will be noted that 18 metres clearance is necessary at this range. The clearance is, therefore, sufficient.

If it is desired to find the clearance of the lowest shot, subtract the figure at the top of the diagram. (Use the "metres" or "yards" figures according to the unit in which you are working.) In this example the clearance of the lowest shot will be  $23 - 3$  metres, *i.e.*, 20 metres.

(c) To find the clearance above an obstacle—Suppose there is a hill crest at a range of 1,600 yards at a height of 239 metres (*i.e.*, 134 metres above the gun). Find this point on the scale as before. It will be noticed that the curve exactly cuts it. The upper half of the cone will, therefore, clear the hill but the lower half will hit it. In order that the whole of the cone may clear the obstruction, the clearance must not be

less than half the height of the cone at the distance from gun to top of the obstruction (see Column 4, Table 1).

NOTES.—The yard scales can be used in place of the metre scales in the case of maps contoured in yards, or where it is required to find the clearance in yards.

It will be found more easy to read the graph if a pin is stuck into the position of the target and that of the troops or obstruction when found.

The range corresponding to any given angle of quadrant elevation can be found by following the Q.E. curve until it cuts the zero line, *e.g.*, range 2,500, target 15 metres above the gun, Q.E. is  $7^{\circ} 50'$ ; follow this curve along; it cuts the zero line at a range of 2,550 yards, which is the range corresponding to this angle.

#### PARA. 11.—HOW TO ADJUST THE NO. 2 (BARR AND STROUD) RANGEFINDER.

This Section is not intended to be a complete treatise on the adjustment of the rangefinder, but aims merely at enabling an officer to determine whether the instrument which the rangetaker is using is correctly adjusted or not, and if not, gives him one way of adjusting it.

There are two tests.

- (1) The height of image test.
- (2) „ zero test.

#### HEIGHT OF IMAGE TEST.

Figure 1 shows correct adjustment—*i.e.* images touch dividing line simultaneously. Figure 2 shows incorrect adjustment.

If the images do not appear as in Figure 1 proceed as follows:—

Fix the instrument on its tripod stand, mount on a steady foundation, and focuss carefully.

Turn the ring near the left end of the rangefinder, until the height-of-image adjusting head is uncovered.

Direct the rangefinder so that the erect image of the object just touches the dividing line.

Rotate the adjusting head until the same point on both images touches the dividing line simultaneously.

Turn the protecting ring to cover the adjusting head.

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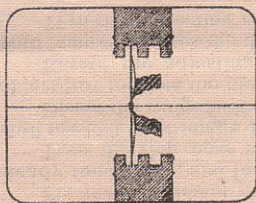


FIG. 1.

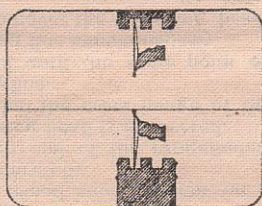


FIG. 2.

#### ZERO TEST AND ADJUSTMENT.

The zero may be tested and adjusted by any one of five different methods. One only will be given—*i.e.*, that using the rods in the wood case.

Proceed as follows :

Adjust height of image, using stand.

Select a suitable piece of ground and send a man with case and rods to a point between 300 and 500 yards away. The man will then put the rods into their sockets, with black or white side towards the instrument whichever is the easier seen. The box should be level on the ground and placed parallel to the instrument by aligning one end of the box on the corresponding end of the instrument.

Six readings will now be taken, making coincidence as shown in Figure 3. If the zero is in correct adjustment the mean of these readings should give infinity.

Should the mean of the six readings bring the infinity mark anywhere on the reader, note the point, make no adjustment and take subsequent readings from that point on the reader. (Figure 4 shows reading half-way between apex and lower base angle).

If the mean of the infinity readings brings the infinity mark right off the reader, adjust as follows :—

Place infinity mark opposite reader, by means of working head. Uncover zero adjusting head and turn the adjusting head till perfect coincidence is obtained. Cover the adjusting head, and again take six readings noting which portion of the reader is opposite infinity. Repeat if necessary till the zero comes opposite some part of the reader. Mechanical adjustment for zero will necessitate the checking of the H.I.

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### NOTES.

- (i.) The dividing line should cut the rods at right angles.
- (ii.) Rods must stand out well from their background.
- (iii.) Adjuster should observe while adjusting.
- (iv.) Coincidence should be made well down on the rods.

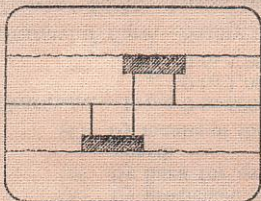


FIG. 3.

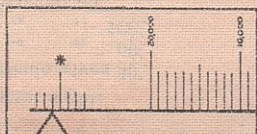


FIG. 4.

## CHAPTER I., SECTION 2.

### COMBINED SIGHTS.

Combined Sights is a method of engaging any required depth of ground by applying simultaneously overlapping zones of fire from two or more guns.

**RULE.**—Always use as many guns as possible: if the error in rangefinding is probably considerable, use 100 yards differences; if the error in rangefinding is probably small, use 50 yards differences.

This rule is based on the assumption that the maximum number of guns under the control of one officer will not exceed four when combined sights are being used.

## CHAPTER I., SECTION 3.

### DIRECT OVERHEAD FIRE.

The following rules and data are for use with *direct* overhead fire. For *indirect* overhead fire, see Section 6.

#### RULES.

1. If the range to target is 1,000 yards or under, the safety angle must be 30'; over 1,000 yards, 60'; over 1,500 yards, 100'.
2. Overhead fire must be discontinued if, or when, the friendly troops advance beyond 2,000 yards from the gun.
3. The range to the target must be accurately known to within 5 per cent. of error.
4. Barrel and tripod not worn.
5. No. 1 a good firer.
6. Tripod well dug in or a firm base provided for the feet.
7. Target, and our own troops at the safety limit, must be clearly visible.

#### NOTES.

- (i) In order to obtain the safety angles required by rule 1, it will often be necessary to seek commanding positions for the guns, *i.e.*, rising ground, upper stories of houses, etc.
- (ii) Safety angles may be applied, either :—
  - (a) By graticuled glasses.
  - (b) By lines for overhead fire given on graticule card.
  - (c) By means of the tangent sight.

*Graticules.*—From 0 to 600, graticule gives 30'.

„ 0 to 1,000 „ „ 60'.

„ 0 to 1,300 „ „ 100'.

*Graticuled Card.*—Safety lines marked on.

*Tangent Sight.*—Lay on target with tangent sight slide set for correct range to target; then raise the slide 300 yards.

With the tangent sight method, the firer must note carefully the auxiliary aiming mark obtained after raising the slide; after firing, he should relay on this auxiliary

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aiming mark. If he is traversing, he must find a second auxiliary aiming mark at the other end of the line to be traversed, and must traverse along an imaginary line joining the two auxiliary aiming marks, and parallel to the enemy's position.

- (iii) The tangent sight method and either graticules or graticule card should be used simultaneously, in conjunction with, and as a check on each other.
- (iv) When the heads of our own troops become visible to the firer over his sights, he should not cease fire. He should elevate his gun, taking the *enemy position* as his auxiliary aiming mark.
- (v) Rule 2 is necessary, because the position of the lowest shot of the 90 per cent. cone is uncertain beyond 2,000 yards.
- (vi) For notes on the life of barrel for overhead fire, see Chapter I., Section 6, Note (vi).
- (vii) While the methods detailed for direct overhead fire may be used when visibility obtains, arrangements should be made to carry on by indirect methods (see Chapter I., Section 6) in case visibility fails owing to smoke, shell fire, &c. This could only be done when the advance of the infantry has been regulated by the artillery time table.

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## CHAPTER I., SECTION 4.

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### INDIRECT FIRE.

#### GENERAL.

Indirect fire is fire directed at some object which is invisible to the firer. Direction and elevation are obtained, put on, and maintained by any of the methods given in the table below. In many cases two or more alternative methods are open to employment. That most suitable under the circumstances will naturally be chosen.

Fire may be indirect by reason of :—

- (1) darkness, smoke or gas cloud, rain or fog, etc.
- (2) some natural or artificial obstruction intervening between gun and target.

*Note.*—In the latter case, it is necessary to determine whether the shots will clear the obstruction. For method of doing this see Section 7.

Indirect fire may be either observed or unobserved. If observed, its value is much increased, and fire may be directed on to the target with rapidity and confidence.

The fact that observation is seldom possible, however, does not mean that indirect fire can not be applied to a point target. With care, and under favourable atmospheric conditions, good results may be obtained. More suitable objectives for indirect fire are areas of ground which include the target, such as dumps, railheads, important junctions of C.T's., tracks known to be used by the enemy, buildings (and their surroundings) used as headquarters, &c. It is also largely employed for frontal, oblique or flank barrages.

When laying the gun for indirect fire, direction should always be put on before elevation. The importance of rigidity in the mounting and platform, should always be borne in mind.

	<i>Direction.</i>	<i>For details see</i>	<i>Elevation.</i>	<i>For details see</i>
Obtained by	Posts alone	Para. 1		
	Map and Protractor	„ 2	Graticules (give also direction)	Para. 8
	Map, Protractor and Reference Object	„ 3	Contoured Map	„ 9
Put on by means of	Posts alone	„ 1	Clinometer	„ 10
	Posts and Compass	„ 4	Elevation Dial	„ 11
	Reference Object & Direction Dial	„ 5	Tangent Sight	„ 12
Maintained by	Aux. Aiming Mark	„ 6	Clinometer	„ 13
			Elevation Dial	„ 14
	Direction Dial	„ 7	Aux. Aiming Mark & Tangent Sight	„ 15



*Addendum to Note 2 below, re selection of a reference object :—*

If, however, a reference object can be found which is near the target position (*i.e.*, within 200 or 300 yards of it), this will give the most accurate results.

### ERRORS IN INDIRECT FIRE.

These may be divided into lateral errors and errors in range. The latter are to a great extent counter-balanced by the length of the beaten zone. A small degree of searching should, however, always be employed to ensure a point target being covered by fire.

Lateral errors are more serious. They may be considerable unless great care is taken, and the width of the cone, being slight, will not go far to counter-balance them.

In the case where the gun is aligned by compass, the lateral error should not be large, provided that the error of the compass is known and allowed for, and care is taken to avoid taking bearings with iron or steel near the compass. If these precautions are taken, and correct allowance made for wind, the error will be no more than the error (if any) made in locating the gun position.

If, however, direction has been obtained by the use of a reference object found on the map, the error can be very considerable if the gun position has not been accurately located. To reduce this to a minimum, the following precautions should be observed :—

- (1) Check the gun position as carefully as possible, if necessary by resection.
- (2) *Choose a reference object as far away from the gun as possible and as nearly as possible in the same direction as the target.*

If care is exercised, there should never be an error in direction of more than 30'  $\therefore$  a traverse of 1° should include the target. If wider traversing is employed, it means a greater expenditure of ammunition and a waste of fire effect.

### PARA. 1.—HOW TO OBTAIN DIRECTION BY POSTS ALONE.

The gun position having been approximately selected, two of the gun's personnel advance with posts, until the target is visible. Two posts are then planted in such a manner that the target and these two posts lie on the same straight line, and the prolongation of this line passes somewhere near the gun position. If these posts are not visible to the firer, a third is driven in still nearer to the gun and in exact alignment with the other two; the

procedure is repeated, if necessary, until two posts are visible to the firer, who will move his gun, aligning it on both simultaneously.

If a commanding position is available in rear of the gun, which allows of both gun and target being seen at the same time, an aiming post can be quickly planted in exact alignment between gun and target by an assistant dressing it from that position.

Once direction has been obtained by this method, it can be put on by laying the gun on the posts.

PARA. 2.—HOW TO OBTAIN DIRECTION BY MAP  
AND PROTRACTOR.

The grid bearing of the target from the gun position is worked out on the map. If the target to be engaged is a linear one, the grid bearings of its limits must be obtained. Occasionally magnetic bearings are employed, but grid bearings are more usual.

PARA. 3.—HOW TO OBTAIN DIRECTION BY MAP,  
PROTRACTOR, AND REFERENCE OBJECT.

The exact position of the gun having been marked on the map, the best method is to select a reference object, which is both marked on the map and visible from the gun position. If the only suitable reference object visible from the gun position is *not* marked on the map, the magnetic bearing should be taken from the gun position, and a line showing its direction drawn through the gun position on the map. On the map, by means of a protractor, measure the angle included between lines joining target to gun, and reference object to gun. If the target to be engaged is a linear one, measure the angles included between lines joining its limits to the gun and the reference object to the gun.

PARA. 4.—HOW TO PUT ON DIRECTION BY MEANS OF  
POSTS AND COMPASS.

*First Method.*—To lay out an aiming post, drive in a stick (not more than 6 inches high) at gun position, and place compass on top. Rotate compass, till card reads the required magnetic bearing found in Para. 2. Align a post on this bearing, using hair line on compass.

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Place gun and tripod with centre of cross at bottom of socket immediately over the first stick, and lay on post put out. This procedure can be carried out by night, but a luminous mark of some description must be used in place of the aiming post.

*Second Method.*—An officer or N.C.O. goes out about 20 yards in any convenient direction.

He then takes a bearing on to the gun with the compass; at the same time the gun is laid on the compass and the reading of the direction dial noted.

The compass reading—which is really the back bearing of the compass position from the gun—is then converted into a forward bearing by adding or subtracting  $180^{\circ}$ .

The difference between this forward bearing and the magnetic bearing on which the gun has to be laid, is noted, and the gun is swung right or left as may be necessary, through a corresponding number of degrees on the direction dial.

The gun will then be laid on the required bearing, and an auxiliary aiming mark should be aligned as in Para. 6.

*Third Method.*—By means of the compass tower.

The compass tower is a device for laying the gun for direction on any compass bearing, and consists of a pillar (made of non-magnetic metal or wood), which is set on the crosshead of the tripod and on which the compass is mounted.

A description of the metal form of the tower may be found in No. 1 "Summary of Machine Gun Intelligence," Para. 29.

A description and working drawings of the wooden form are given in No. 3 "Summary of Machine Gun Intelligence," Para. 94. (A copy of this description and drawing will be forwarded on receipt of a postcard addressed to: Chief Instructor, Machine Gun School, M.G.T.C., England.)

The method of use is as follows:—

*To adjust:* Lay the gun on some distant object, and tighten the traversing clamp securely. Remove the gun from the crosshead to a distance of at least three yards.

Place the compass tower in position on the crosshead, replace crosshead joint pin, and clamp the tower in position by means of clamping nut.

Place the compass on the table, and align it on the object by rotating the compass. Bring the sight vane of the compass tower into alignment with the hair line of the compass, and clamp up the sight vane.

The compass tower will now be in adjustment.

*To lay the gun on any Magnetic Bearing:* Remove the gun from the vicinity of the tripod and loosen the traversing clamp; place the compass tower on the crosshead, and align the hair line of the compass on the slit of the compass tower sight vane.

Rotate the crosshead until the required reading is seen on looking through the compass prism (or its equivalent). Clamp up traversing clamp, loosen slightly clamping nut of compass tower and withdraw the crosshead joint pin: remove compass tower from the crosshead, and replace the gun which will now be pointing in the required direction.

PARA. 5.—HOW TO PUT ON DIRECTION BY MEANS OF A REFERENCE OBJECT AND DIRECTION DIAL.

The gun is laid with any convenient range on the sights on part of the reference object which has been used when working out the direction from the map: it need not be levelled, but the crosshead should be upright. The direction dial should now be set to read zero (or the reading noted, if the dial cannot be rotated). The gun is now swung right or left through the angle required according as the reference object is left or right of the target.

PARA. 6.—HOW TO MAINTAIN DIRECTION BY AN AUXILIARY AIMING MARK.

Once the gun has been laid, the tangent sight slide only may be adjusted, so as to bring the line of sight on to any suitable natural or artificial aiming mark. Between bursts of fire the firer should note whether the gun has shaken off the mark, and if so, relay.

PARA. 7.—HOW TO MAINTAIN DIRECTION BY MEANS OF THE DIRECTION DIAL.

The gun having been laid for direction, the reading of the direction dial is noted. Direction can be maintained during firing, by ensuring that the pointer is set accurately to this reading.



PARA. 8.—HOW TO CARRY OUT INDIRECT FIRE  
BY GRATICULES.

PROCEDURE :—

- (1). Obtain range to target.
- (2). Move to a position whence the target can be observed, if possible on the line joining gun and target.
- (3). Select a suitable aiming mark above or below the target, in alignment with the gun and target. This aiming mark must not be closer to the gun than 100 yards, and the further away the better.
- (4). Align the graticule representing the range to the target on the target, and note which graticule cuts the aiming mark chosen.
- (5). Order the firer to lay on the aiming mark, using a tangent elevation corresponding to the graticule cutting that mark.

NOTES.

- (i.) The person using the graticule card should not be more than a few feet above or below the gun.
- (ii.) He should not be much nearer to, or further away from, the target than the gun.
- (iii.) If fire can be observed, alterations in direction and elevation can be rapidly effected by tapping the gun, or turning the wheel, respectively.
- (iv.) If it be desired to alter elevation and use the tangent sight, it must be remembered that the position of the slide does not indicate the range to the target, and recourse must therefore be had to alterations by clicks. There are, roughly, as many clicks on the ratchet of the tangent sight as there are hundreds of yards in the range, at all ranges below 1,500 yards. Thus to throw the cone 50 yards further away when firing on a target distant by 1,200 yards, the order would be "up six clicks," no matter what range was shown on tangent sight. If 100 yards more elevation were required, the order would be "up 12 clicks." The firer would then relay on the original aiming mark.

PARA. 9.—HOW TO OBTAIN ELEVATION BY  
CONTOURED MAP.

Having noted on the map the exact positions of gun and target, and the contours on which they lie, measure

the distance between them to obtain the range, and by subtraction of contours determine the V.I. Convert both into yards if necessary. See Section 1.

Then use Table 3 (A) or 3 (B) to obtain directly the angle of quadrant elevation to put on the gun, or this can be done without any conversion by means of the graph issued with this book.

The angle of quadrant elevation is a combination of the tangent angle for the range to the target and the angle of sight from the gun to the target, and can be worked out as follows:—

Using the formula in Section 1, Para. 1, work out the angle of sight to the target, noting whether it is positive or negative.

From Table 1, Column 2, obtain the angle of tangent elevation corresponding to the range.

Combine the angle of sight and the angle of tangent elevation to obtain the angle of quadrant elevation.

The angle of quadrant elevation found by any of the above methods may be put on the gun directly by means of the clinometer or the elevation dial (see Para. 10 or 11), but if it be desired to put on elevation by means of the tangent sight (see Para. 12), the angle found must be converted into the equivalent range by means of Table 1, Columns 1 and 2, or from the graph.

PARA. 10.—HOW TO PUT ON ELEVATION BY THE  
CLINOMETER.

(a) Adjust the clinometer to read the required angle.

(b) Place the clinometer on the tangent sight bridge, just clear of the projecting part of the tangent sight piston, with the arm of the clinometer directly over the bridge throughout its whole length, and the graduated arc to the rear. *No. 1 should maintain "holding" pressure.*

(c) Elevate the gun by turning the elevating wheel until the bubble is central, No. 1 maintaining "holding" pressure. When the bubble is central, the required angle of elevation will be on the gun.

NOTE.—If a negative quadrant angle is to be placed on the gun (*i.e.*, if the gun has actually to be depressed), the clinometer must be placed on the gun with the graduated arc forward instead of to the rear.

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PARA. 11.—HOW TO PUT ON ELEVATION BY  
ELEVATION DIAL.

PROCEDURE :—

(1) Level gun by spirit level, No. 1 taking the holding pressure.

(2) Set dial to zero, and clamp up.

(3) Rotate dial until required angle is placed on gun.

*Notes.*—(a) If an angle greater than  $4^{\circ}$  is being put on, one complete revolution must be made first. Thus  $7^{\circ} 15'$  is one turn plus  $3^{\circ} 15'$ .

(b) Instead of setting the dial to zero, the required elevation may be put on by simply rotating the dial through the required amount, after noting the reading when the gun is level.

PARA. 12.—HOW TO PUT ON ELEVATION BY MEANS OF  
TANGENT SIGHT.

Four cases may occur, as follows :—

1. The quadrant angle is positive, and auxiliary aiming mark can be seen or put out, as in Case I. below.

2. The quadrant angle is negative, and auxiliary aiming mark can be seen or put out, as in Case II. below.

3. The quadrant angle is positive, and auxiliary aiming mark cannot be seen or put out when gun is level, as in Case III. below.

4. The quadrant angle is negative, and auxiliary aiming mark cannot be seen or put out when gun is level, as in Case IV. below.

*Note.*—Cases 3, and 4, might occur when the ground sloped down steeply in front of the gun.

Proceed in all cases as follows :—

Level gun by spirit level, No. 1 taking the holding pressure.

Then :—

*Case I.*—Run tangent sight slide to zero and select a natural aiming mark (or place out an artificial one) at least 100 yards away from the gun. Run up tangent sight slide to range corresponding to quadrant angle, and relay on the auxiliary aiming mark.

*Case II.*—Run up tangent sight slide to range corresponding to angle of quadrant elevation, disregarding sign. Select a natural aiming mark (or place out an artificial one)

at least 100 yards away from the gun. Run tangent sight slide down to zero, and relay on the auxiliary aiming mark.

*Note.*—Particular care must be taken that the shots will clear the ground in front of the gun.

*Cases III. and IV.*—Run up tangent sight slide until a natural (or artificial) aiming mark is visible at least 100 yards away from the gun. Note range on tangent sight, and convert into an angle by Table 1, Column 2. In Case III. *add to*, and in Case IV. *subtract from* this angle the angle of quadrant elevation it is desired to put on the gun, and convert the answer into a range by Table 1, Columns 1 and 2. Run tangent sight slide to this new range, and relay on auxiliary aiming mark.

PARA. 13.—HOW TO MAINTAIN ELEVATION BY THE  
CLINOMETER.

When the gun has been laid, the clinometer must be taken off, but kept adjusted to the required angle. When it is desired to check the elevation of the gun, the clinometer must be replaced, *No. 1 maintaining "holding" pressure*. If the bubble is found to be central no alteration need be made; if not, the gun must be adjusted by the elevating wheel until the bubble is central. The clinometer can then be taken off and the firing continued.

PARA. 14.—HOW TO MAINTAIN ELEVATION BY THE  
ELEVATION DIAL.

Between bursts of fire, the firer should make sure that the pointer continues to show the same quadrant elevation on the dial as was originally put on the gun. If this method is to be reliable, it is essential that the legs of the tripod shall not sink unevenly into the ground: in other words the tripod must be on a firm foundation. It is desirable, where possible, to use an auxiliary aiming mark in addition, but if this be not possible the procedure laid down in Para. 11, for putting on elevation, should be repeated at frequent intervals. It should be noted that unless the socket is *absolutely* upright, the quadrant elevation may vary considerably if the gun is traversed through a wide arc, though the reading of the elevation dial will not alter.

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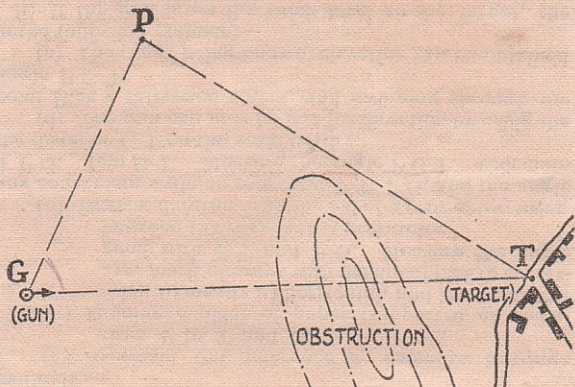


PARA. 15.—HOW TO MAINTAIN ELEVATION BY AUXILIARY AIMING MARK AND TANGENT SIGHT.

Once the gun has been laid, the tangent sight slide (only) may be adjusted so as to bring the line of sight on to any suitable natural or artificial auxiliary aiming mark—e.g., illuminated box, white or luminous stone, post, etc. The range shown on the tangent sight, after adjustment as above, need have no connection with the quadrant elevation on the gun; therefore, alterations in elevation, if required, must be made by turn of the wheel. When the correct elevation has been obtained, the slide (only) should be re-adjusted so as to bring the line of sight again on to the auxiliary aiming mark.

The distance between the gun and the auxiliary aiming mark is immaterial when *maintaining* elevation, and in this respect differs from the minimum distance laid down in Para. 12, when *putting on* elevation. Normally, however, it should not be less than 10 yards.

PARA. 16.—A METHOD OF INDIRECT FIRE WHEN NO MAP IS AVAILABLE, BUT WHEN AN OBSERVER CAN SEE BOTH TARGET AND GUN POSITION BY MOVING TO A FLANK.



PROCEDURE.

Proceed to the point P, from which both target and gun position can be seen.

(a) With the rangefinder ascertain the distances P T and P G.

(b) Measure the angle T P G by either of the following methods:—

(i.) Ascertain the difference in compass bearings from P to T and G.

(ii.) Holding a piece of paper (supported on something to steady it) horizontal, and level with the eye, mark out rays with the aid of pins to correspond with P T and P G. Measure the angle between the rays with a protractor.

(c) Draw a diagram with the aid of a protractor, using any convenient scale, to represent P T, P G, and the angle T P G. Join G T. Measure the angle P G T. Calculate the distance G T on the scale used.

(d) The gun can now be laid for direction by using the point P as a reference object, and swinging through the angle P G T.

(e) The range being known, elevation can be obtained in the following manner:—

(i) If the gun is on the same level as the target, the angle of Q.E. to be put on the gun is the same as the angle of T.E. for the range already found.

(ii) If the gun and target are on different levels, find the angle of sight between P and T =  $t^{\circ}$  and the angle of sight between P and G =  $g^{\circ}$  (see Chapter I., Section 1, Para. 1, Note 3), then the angle of sight between G and T =  $\frac{t^{\circ} \times PT - g^{\circ} \times PG}{GT}$

This angle will be *positive* if T is *above* P, and *negative* if T is *below* P. Similarly with the angles between P and G, and P and T.

The required angle of Q.E. can now be found by adding (if positive) or subtracting (if negative) the angle of sight between G and T, to the angle of T.E. for the range GT.

Notes.—(i.) The rangefinder must be in accurate adjustment.

(ii.) The greatest care must be taken when calculating or laying out the angle T P G.

(iii.) The usual precautions must be taken to ensure that the shots will clear the obstruction.

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## CHAPTER I., SECTION 5.

### NIGHT FIRING.

Three cases will usually occur :—

1. Gun brought up and laid by day ; left in position ready for firing at night.
2. Gun brought up and laid by day ; removed for other work ; brought back again after dark.
3. Gun brought up into position for the first time by night.

(The following abbreviation is employed : "A.A.M." for "Auxiliary Aiming Mark.")

1. PROCEDURE : Gun brought up and laid by day ; left in position ready for firing at night :

BY DAY :

- (a) Obtain range to target, and lay gun on it. See Note (i).
- (b) Put a sentry over the gun to ensure that it is not touched.

BY NIGHT :

- (c) Send out a spare number with a luminous A.A.M. Adjust the tangent sight and the position of the A.A.M. until the sights are aligned on it (taking care that the *direction and elevation of the gun are not altered*). See Note (ii).
- (d) Direction and elevation can now be maintained by relaying on the A.A.M.

NOTES :

- (i) If the target is not visible, indirect means must be employed to lay the gun (see Section 4).
- (ii) It may be possible to put out an A.A.M. by day, unseen by the enemy.

If it is not possible to put out an A.A.M. at all, maintain direction by the direction dial and elevation by the clinometer or elevation dial (see Section 4).

If several targets are to be engaged, a separate A.A.M. must be used for each, and the respective readings of the tangent sight noted for each A.A.M.

An alternative, if no A.A.M. can be put out, is to lay the gun on each target in succession by day. The respective readings of the direction dial should be noted for each target.

The elevation required for each target can be ascertained (from clinometer or elevation dial) and noted.

At night, the gun can be laid on any desired target by means of the dials; direction and elevation can be maintained as in Section 4.

2. PROCEDURE: Gun brought up and laid by day; removed for other work; brought back again after dark:

By DAY:

- (a) Obtain range to target, and lay gun on it. If target is not visible, indirect means must be employed to lay the gun.
- (b) Put out an A.A.M.: taking care not to alter the direction or elevation of the gun, adjust the tangent sight and the position of the A.A.M. until the sights are aligned on it. See Note (iii).
- (c) Note reading on tangent sight.
- (d) Mark the exact position of the tripod feet on the ground, and note the height of the tripod. See Note (iv).

Gun and tripod can now be removed. When replacing at night:—

- (e) Mount tripod in exactly the same position, and at the same height as before, and replace the gun.
- (f) Adjust tangent sight to reading noted in (c), and lay the gun on the A.A.M. (which must be illuminated).
- (g) Gun is now laid on target: direction and elevation can be maintained by relaying on A.A.M.

NOTES:

- (iii) In soft ground it is advisable to place the A.A.M. some distance from the gun (say 10 yards), so that errors in elevation due to possible sinking of the gun during replacements &c. may be minimised. If no A.A.M. can be put out, note:—

The direction dial reading.

The quadrant elevation (by clinometer or by spirit level and elevating dial).

At night, lay the gun by means of the dials (see Section 4).

- (iv) The height of the tripod can be measured by noting the readings on the serrations on the tripod legs. Another way is to mount the tripod in both cases so



that belt box can just be placed underneath the socket. A third way is to drive a peg into the ground, so that it just touches the underneath of the socket.

3. PROCEDURE: Gun brought up into position for the first time by night:

(A) PROCEDURE if it is possible to get by day to the position on which the gun will be mounted by night.

- (a) Drive in a peg, about 6 inches high, to mark position over which tripod will be mounted at night.
- (b) Put in a second peg to give direction: This can be done by direct alignment if target is visible, or by compass bearing. See Note (v).
- (c) Obtain angle of quadrant elevation.

BY NIGHT:

- (d) Mount tripod over peg (a): centre lines at bottom of socket must be exactly over the peg.
- (e) Place a luminous A.A.M. on peg (b): this will give direction.
- (f) Put on quadrant elevation by most convenient method.
- (g) Maintain direction and elevation by the A.A.M.

(B) PROCEDURE if it is *not* possible to get by day to the position on which the gun will be mounted by night.

- (a) Obtain from the map the magnetic bearing of the target from the gun position, and the necessary angle of quadrant elevation.
- (b) On arrival at the gun position, direction is put on as in Section 4, Para. 4, and elevation by the most suitable method (clinometer).
- (c) A luminous A.A.M. can then be placed out for maintaining direction and elevation.

NOTES:

- (v) This peg could be put out to a flank, or even in rear of the gun position if desirable: it would then be used in the same way as a reference object, and direction obtained by use of the direction dial.
- (vi) An A.A.M. forms a more convenient means of maintaining direction and elevation than the dials, and it is more accurate when the ground is soft.

- (vii) A better method than the use of the elevation dials for measuring quadrant elevation is by the clinometer.

#### RELIEF OF GUNS LAID ON NIGHT LINES.

The above methods can be adapted to the relief, during darkness, of a gun laid on a definite target, by another gun to be laid on the same target.

If the outgoing gun has been maintaining direction by the direction dial alone, an A.A.M. must be placed out before the gun is removed. The incoming gun can then obtain direction from the A.A.M., which may be put either outside, or inside if the emplacement is a closed one. Elevation may be measured and put on by the most convenient method (clinometer).

If the tripod of the outgoing gun can be left in its place, and the tripod of the incoming gun handed over in exchange, an A.A.M. need not be placed out, as the incoming gun can be laid to the same direction dial reading.

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### CHAPTER I., SECTION 6.

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#### INDIRECT OVERHEAD FIRE.

The general remarks on indirect fire given in Chapter I., Section 4, apply equally to indirect overhead fire. It is particularly suited to trench warfare, where ranges are usually accurately known and hostile movements can to a certain extent be predicted.

This type of fire is employed for two main purposes:—

Harassing fire,  
Barrage fire.

Harassing fire is intended to annoy and impede the enemy as much as possible, and to lower his morale by inflicting constant casualties upon him. It may be directed upon such targets as places of assembly or concentration, dumps, light railways and tramways, communications, places where work is in progress, headquarters and their surroundings, repair parties, etc.

For large operations, harassing fire may be co-ordinated in the general scheme of machine gun work.

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Barrage fire (see Chapter I., Section 9) is employed during offensive operations to assist the advance of our own troops; in the defence and during consolidation, it affords protection against hostile attacks. For barrage fire, all the guns on a divisional or corps front are organised according to one general scheme.

In considering its employment, the following are the deciding factors :—

- |                              |                         |
|------------------------------|-------------------------|
| 1. Safety of our own troops, | 4. Effect on gun teams. |
| 2. Effect on enemy.          | 5. Supply of ammunition |
| 3. Wear of gun and tripod.   | available.              |

#### RULES.

(1). The following table gives the minimum height at which the centre of the cone of fire must pass *above the heads* of our own troops at any given distance from the gun :—

#### MINIMUM SAFETY CLEARANCES.

##### INDIRECT OVERHEAD FIRE.

Distance of our own troops from the gun, in yards.	Minimum clearance in yards.
100	11
200	11
300	11
400	11
500	11
600	11
700	13
800	15
900	17
1000	20
1100	23
1200	27
1300	31
1400	35
1500	40
1600	46
1700	53
1800	60
1900	69
2000	80

(2). Our own troops must not be more than 2000 yards from the gun (see Section 3, Note (5.)).

(3). Steps must be taken to prevent such extremes of traversing and searching as would contravene rule (1).

(4). Maps used must be accurate. A scale smaller than 1—20,000 is inadmissible, and 1—10,000 is advisable.

(5). Troops concerned must be warned.

(6). Calculations must be checked independently.

(7). Worn barrels or mountings must not be employed.

(8). The best available firer must be used.

(9). Tripods must be well dug in, or a firm base provided for the feet.

#### NOTES.

(i.) All the instructions and methods given for carrying out indirect fire (see Section 4), apply of course to indirect overhead fire.

(ii.) The following sketch will show how careless traversing will endanger our own troops :—

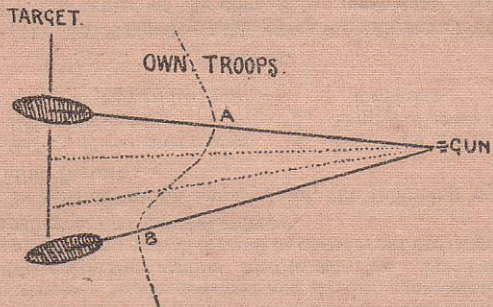
Range to own troops 900 yards.

Safety clearance required = 17 yards.

Actual clearance obtained at point A, say = 25 yards.

Therefore it is safe to fire.

If now the gun were much traversed to the left the clearance would shortly be reduced to a dangerous extent.



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(iii.) Do not use indirect overhead fire if our own troops are in movement above ground, unless their position with respect to the safety limits is accurately known.

(iv.) Some form of flash protector is most desirable, and its use may enable the gun to remain for long periods undetected in some position particularly suited to the work.

(v.) The probable damage to the enemy depends on the intelligent selection of targets, and this again depends on the nature of the target, the type of fire directed on it, the care in preparation, and close co-operation with the artillery. Sweeping small areas of ground at suitable hours is most likely to give good results.

In selecting targets and deciding on the best time of day to engage them, information should be sought from infantry patrols, front line troops, artillery observers and battery commanders, the R.F.C. (aerial and ground photographs), and the intelligence summaries.

(vi.) Although nothing in the nature of a hard and fast rule can be laid down as to the life of a barrel for overhead fire, the following figures may be taken as a guide. They are the results of firing several million rounds.

(a) In the case of a low rate of fire with regular and continuous cleaning and oiling, and where the water in the barrel casing is not boiling continuously, the average life of a barrel for overhead fire is about 20,000 rounds.

(b) In the case of rapid and continuous fire as used for S.O.S. calls and offensive barrage work, the life is between 12,000 and 15,000 rounds, for overhead fire.

(c) When computing the number of barrels required for an operation, the life of a barrel may be taken (as a rough guide) at 15,000.

NOTE.—For fire other than overhead fire, the average life is about 25,000 rounds.

(vii.) Care must be taken that barrels do not become nickelled, as this may cause serious inaccuracies in shooting.

Nickelling deposit should be removed by means of the double pull-through whenever opportunity occurs: if allowed to accumulate it becomes increasingly difficult to remove.

(viii.) In flat country, or in cases where it may happen that the gun, target, and our own troops all lie on the same plane (not necessarily horizontal), the application of

rule (1) to the trajectory tables, gives the following table, assuming the heads of our own troops to be at ground level.

Range to target in yards.	Safety zone for own troops in yards.
1300	500 to 700 from gun
1400	400 " 900 " "
1500	400 " 1000 " "
1600	300 " 1100 " "
1700	300 " 1200 " "
1800	200 " 1300 " "
1900	200 " 1500 " "
2000	200 " 1600 " "
2100	200 " 1700 " "
2200	200 " 1800 " "
2300	200 " 1900 " "
2400 and over.	100 " 2000 " "

Whenever the gun, target, and our own troops do not lie on the same plane (which is the normal situation), the clearance must be determined as follows:—

(ix.) HOW TO DETERMINE THE CLEARANCE.

(a) From the Graph (see Section 1, Para. 10.)

(b) *From the tables.*—In order to find the clearance, *i.e.*, the height from the ground to the centre of the cone at any point in the line of fire, the following is the simplest and most accurate method, which can be used:—

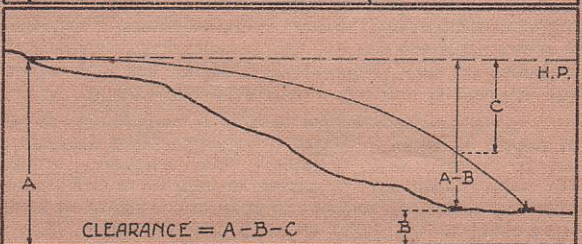
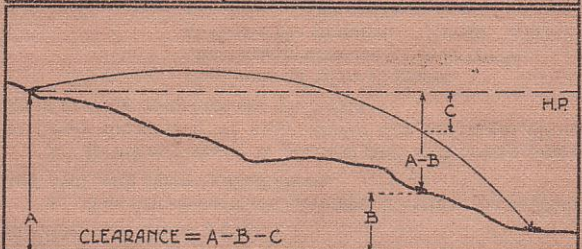
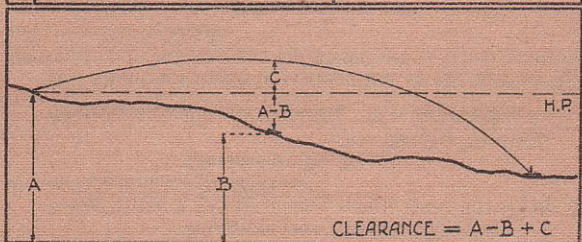
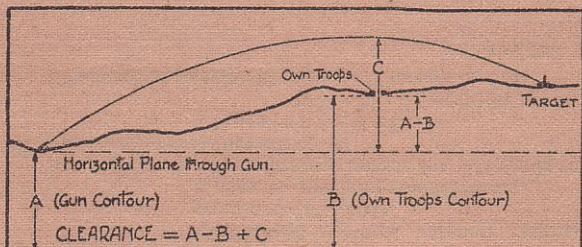
- Let gun contour ... .. = A yards.  
 „ own troops contour ... .. = B „  
 „ centre of cone above or  
 below horizontal plane  
 through gun position  
 when passing over own  
 troops heads ... .. = C „

$$\text{Then clearance (yards)} = A - B \begin{matrix} + \\ \text{or} \\ - \end{matrix} C.$$

C must be added or subtracted according as the trajectory at the distance our own troops from the gun is above or below the horizontal plane through the gun position.

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2. In order to find C, either Table 2 (A) or Table 2 (B) must be used according as to whether the quadrant angle on the gun is positive or negative. On these tables, the words "positive" and "negative" are printed. If the trajectory height found is positive, C must be added to  $A - B$ ; if negative, it must be subtracted from  $A - B$ .

3. If the quadrant angle on the gun is positive, the angle, and the range corresponding, can be found in Columns 1 and 2, Table 2 (A). If the quadrant angle is negative, it is unnecessary to convert it into a corresponding range, and the negative angle is used directly in conjunction with Table 2 (B).

4. The following three examples illustrate the method and deal with three typical cases.

I. Quadrant angle is positive and sufficiently large to throw the centre of cone above the horizontal plane when passing over own troops heads.

EXAMPLE. Gun contour (A) = 70 yards.  
Own troops contour (B) = 20 yards.  
Q.E. = +86 minutes. Range corresponding = 1,200 yards.  
Range to own troops = 900 yards.

From Table 2 (A) trajectory height for 1,200 yards at 900 yards = 9 yards (positive) = C.

$$\begin{aligned}\text{Clearance} &= A - B + C. \\ &= 70 - 20 + 9 = 59 \text{ yards.}\end{aligned}$$

Clearance required = 17 yards. It is safe to fire.

II. Quadrant angle is positive but small, so that the centre of cone is below the horizontal plane when passing over own troops heads.

EXAMPLE. A and B as above.  
Q.E. = +35 minutes. Range corresponding = 700 yards.  
Range to own troops = 900 yards.

From Table 2 (A) trajectory height for 700 yards at 900 yards = 4.5 yards (negative) = C.

$$\begin{aligned}\text{Clearance} &= A - B - C. \\ &= 70 - 20 - 5 (\text{say}) = 45 \text{ yards.}\end{aligned}$$

Clearance required = 17 yards. It is safe to fire.

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III. Quadrant angle is negative.

EXAMPLE. A and B as above.

Q.E. = -75 minutes.

Range to own troops = 900 yards.

From Table 2 (B) trajectory height for -75 minutes at 900 yards = 33.2 yards (negative) = C.

Clearance = A - B - C.

= 70 - 20 - 33 (say) = 17 yards.

Clearance required = 17 yards. It is just safe to fire.

5. Appendix II. shows copies of an "INDIRECT OVERHEAD FIRE" sheet, and an "INDIRECT FIRE CHART." Certain specimen examples have been filled in on the former, for the purpose of bringing out various points.

## CHAPTER I., SECTION 7.

### CLEARING AN OBSTRUCTION.

In all cases where the target is invisible by reason of the fact that an obstacle intervenes between the gun and the target it is necessary to make sure before firing, that the shots will clear the obstruction. The clearance required is positive and equals half the height of the cone for the distance to the obstruction. See Table 1, column 4. The procedure is as follows:—

(1) After the quadrant elevation necessary to hit the target has been put on the gun, the tangent sight slide will be adjusted to read the range from the gun to the top of the obstruction. If on looking along the sights the obstruction is not visible, the shots will clear. If, however, the obstruction is visible the shots will not clear, and the gun must be moved farther back.

(2) If the range to the obstruction is small (say below 100 yards) the sights should be adjusted to zero, or recourse may be had to looking through the barrel, by the aid of the mirror reflector.

(3) If the obstruction is invisible (such as the summit of a hill hidden by a false crest) neither of the methods given above will apply, and the graph (see Chap. I., Section 1) or the clearance formula given in Section 6, Para (vii) (Indirect Overhead Fire) must be used. The data for use in that formula must be abstracted with reference to the obstruction, the word "obstruction" being substituted throughout for the words "own troops."

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**SEARCHING A REVERSE SLOPE.**

It may sometimes be desired to search the reverse slope of a hill occupied by the enemy, where he is under shelter from short range fire.

Reverse slopes are often chosen by the enemy as suitable areas where troops may be disposed preparatory to attack, or may manœuvre free from observation. It is therefore necessary to know how such ground may be brought under machine gun fire in the most effective manner. Table 7 enables the machine gun officer to search the reverse slope of a hill, and is constructed on the following basis :—

If a gun is placed at such a distance from the crest\* that the cone, just passing over it, will fall at a steeper angle than the slope of the ground on the other side of the hill, then fire effect will be brought to bear on the reverse slope. No endeavour has been made to fit the trajectory exactly to the reverse slope, as the difficulties and variables in the problem are so many, that small errors would upset the results. Traversing and searching should be employed, for the same reasons as govern all forms of indirect fire.

TABLE 7.—This table is so constructed, that when the gun is placed as required by its use, and fire suitably directed at the reverse slope, the bullets will fall on the slope at an angle of somewhere between 100 and 200 minutes to the slope itself.

The table is divided into two parts :—“ Gun above crest,” and “ Gun below crest.”

The table is used as follows :—

(a) On the map, draw a line from the crest, which will be the probable line of fire.

(b) From the map, determine the average drop IN YARDS in 100 yards, measured from the crest down the slope.

(c) Making use of the two top horizontal columns, note the distance to measure back, which will vary according as the spot thus found is above or below the crest.

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\*The crest may be taken as being either the highest point of the ground, or, as in the case of a flat-topped hill, the point at which a gentle slope changes to a more abrupt one.



NOTE.—Owing to undulating ground it is possible to find that a correct answer is given on both sides of the table. In that case select whichever position is most suitable. EXAMPLE: ground drops 7 yards in 100. At 1,400 yards from the crest the position found might be above the crest, and also at 1,900 yards from the crest the position found might be below the crest.

In rare cases it may be found that neither side of the table is satisfied: if so, choose a position between the two which is on the same level as the crest.

(d) From map note the difference in height between this spot and the crest, above or below as the case may be. Run down the centre column till this height is found.

(e) Then look along horizontally, when the final range from the crest will be found in the vertical column under the drop in yards found in (b).

(f) Place the gun at this point, and lay on the crest by any suitable means, *vide* Section 4.

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## CHAPTER 1., SECTION 9.

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### GENERAL NOTES ON BARRAGE.

"BARRAGE" implies the denial of ground to the enemy. The word is used loosely to mean the bringing of a volume of fire to bear upon an area, or upon an area including a line or point target.

#### ORGANISATION OF GUNS FOR BARRAGE.

Barrage fire is fire, usually indirect, from a number of guns organised by one officer, and firing according to one scheme.

The barrage guns of a division are placed under the command of the divisional machine gun officer. The guns are divided into groups; the groups are sub-divided into batteries. A group normally consists of (two or) three batteries, and a battery of (four, six or) eight guns.

The group is commanded by a group commander, who is usually a company commander, and a battery by a battery commander, who is a senior section officer.

To each gun there should be appointed a gun commander, who will be a N.C.O. or selected private; he should not act as the No. 1 of the gun.

### TYPES OF BARRAGE.

A barrage may be frontal, oblique, or enfilade.

The frontal barrage is most common; it is usually easier to arrange and control: it has the disadvantage that the safety of our own troops usually requires that the barrage shall not be put down nearer than 300 or 400 yards in front of them.

The enfilade barrage may be put down much closer to our own troops than the frontal, but is only possible when circumstances are favourable.

The oblique barrage has the advantages, and disadvantages of the frontal and enfilade barrages according to the degree of obliquity.

The frontal and oblique barrages require traversing; the enfilade does not. Two parallel enfilade barrages about 60x apart should be employed rather than a single enfilade barrage from the same total number of guns.

Each of these types of barrage may be "standing" or "creeping." A creeping barrage "lifts" forward 100x or 200x, for instance, at each lift, and is frequently put down 300x or 400x beyond the 18 pdr. barrage, while a standing barrage remains on its target as long as safety or other considerations permit.

### INTENSITY.

The effectiveness of a barrage, depends upon the number of shots falling upon the beaten area while the enemy are in the beaten area, and the angle of dive of the shots.

The effectiveness increases as the rate of fire increases: it decreases as the angle of dive,\* the speed of the enemy advance, and the frontage per gun increase.

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\*The angle of dive is the angle at which the bullets strike the ground. On horizontal ground it is equal to the angle of descent of the bullets. In other cases, it is the combination of the angle of descent of the bullet, the angle of slope of the ground at the target, and the angle of sight. For example:—Where a near slope is being engaged, and there is a positive angle of sight, the angle of dive is equal to—

Angle of descent plus angle of slope minus angle of sight.

Again, where a reverse slope is being engaged, and there is a negative angle of sight, the angle of dive is equal to—

Angle of descent minus angle of slope plus angle of sight.

It will be found that the effect of slope of ground is very great, and also that the angle of descent increases rapidly with the range.

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The frontage per gun for an intense barrage can be worked out in the following manner:—

$$\frac{\text{Number of rounds fired per min.}}{\text{Rate of Advance in yds. per min.}} \times \frac{\text{Denominator of the angle of dive expressed as a gradient}}$$

EXAMPLES :—

(NOTE.—For simplicity these examples assume that there is no angle of sight, *i.e.*, that gun and barrage line are on the same level).

1. FLAT GROUND.—(Range, 2,000 yards.) In this case note that the angle of dive is the same as the angle of descent.

Rate of fire = 300 rounds per minute.

Probable rate of enemy advance =  $2\frac{1}{2}$  miles per hour (73 yards per minute).

Angle of descent expressed as a gradient = 1 in 6.4.

$$\text{Frontage per gun} = \frac{300}{73} \times 6.4 = 25.6 \text{ yards.}$$

2. REVERSE SLOPE.—(Range 2,000 yards.)

Rate of fire = 300 rounds per minute.

Probable rate of enemy advance =  $2\frac{1}{2}$  miles per hour (73 yards per minute).

Angle of descent =  $541'$ .

Gradient of ground = 1 in 16 =  $209'$ .

Angle of dive =  $541' - 209' = 332'$ : expressed as a gradient this = 1 in 10.2.

$$\text{Frontage per gun} = \frac{300}{73} \times 10.2 = 42 \text{ yards.}$$

3. NEAR SLOPE.—(Range 2,000 yards.)

Rate of fire = 300 rounds per minute.

Probable rate of enemy advance =  $2\frac{1}{2}$  miles per hour (73 yards per minute).

Angle of descent =  $541'$ .

Gradient of ground = 1 in 10 =  $343'$ .

Angle of dive =  $541' + 343' = 884'$ : expressed as a gradient this = 1 in 3.9.

$$\text{Frontage per gun} = \frac{300}{73} \times 3.9 = 16 \text{ yards.}$$

As the rate of fire is limited by the firing capacity of the gun, the supply of S.A.A., etc., it will often be impossible to produce an intense barrage at the longer ranges: this intensity, however, is probably rarely needed, and furthermore the artillery barrage must be taken into consideration.

It should be noted that the effectiveness of a barrage is not influenced by obliquity: if the factors mentioned above are constant, the effectiveness of the barrage will be the same whether the barrage is frontal, oblique, or enfilade.

#### RATES OF FIRE.

“RAPID.”—Maximum rate.

This rate is used for S.O.S., when it is maintained for a few minutes, and followed by “medium” or “slow” fire for a stated time, or until the situation clears.

“MEDIUM.”—1 belt per gun per 2 minutes.

“SLOW.”—1 belt per gun per 4 minutes.

This is the normal rate of barrage fire, and is the greatest rate that can be maintained for long periods.

#### FLEXIBILITY.

It is necessary to arrange that a battery can engage any target within range without loss of time. This end is achieved by careful preparation of maps, etc., and by drill. The system of laying out parallel zero lines for all the guns of a battery on a given grid bearing, which is marked on the maps of the battery and group commanders, is found to be of great use. Each gun should have a zero aiming post, which should not be moved when once it is in position, and these posts should be so placed, that when each gun is laid on its zero aiming post, it is laid on its zero line.

#### COMMUNICATIONS.

The group commander will be in communication by telephone with the divisional machine gun officer through the Headquarters or report centre of the brigade, in whose area his batteries are situated; he will also be in communication with his batteries by telephone, where possible, and by runner.

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## ALLOWANCES FOR ATMOSPHERIC CONDITIONS.

Arrangements should be made with the artillery, so that atmospheric conditions can be ascertained, and the proper allowances made.

## BOX BARRAGE.

Box barrages are frequently required for such purposes as raids, etc. These barrages can be obtained by a combination of frontal with oblique or flanking fire.

## DUTIES OF COMMANDERS.

(a) The duties of the group commander are :—

- (i.) To carry out the orders of the D.M.G.O.
- (ii.) To organise his group into batteries.
- (iii.) To make all preliminary preparations, which include estimates of S.A.A., oil, water, &c.
- (iv.) To make preparation for the formation of dumps and communications.
- (v.) To issue operation orders which deal with the location and tasks of each battery. The tasks are set out in a table showing the times, targets, rates of fire for each lift, and any moves. These orders must be issued in ample time for the battery commander to make his calculations and send these to the group commander to check. (These orders may be issued in the form of a "battery chart.")
- (vi.) To provide himself with a fighting map showing zero lines and tasks of each battery.

(b) The duties of the battery commander are :—

- (i.) To lay out the zero lines of his battery in the position ordered by the group commander.
- (ii.) To carry out orders of the group commander detailed above in (iii.), (iv.), and (v.).
- (iii.) To issue a barrage chart (sometimes called a gun chart) to each gun commander.
- (iv.) To provide himself with a fighting map, showing zero lines and tasks of his battery.
- (v.) To see that every "commander" in his battery, including himself, is provided with an understudy.
- (vi.) To supervise the fire of his battery.

(c) The duties of the gun commander are:—

- (i.) To control the fire of his gun, as ordered on his barrage chart.
- (ii.) To control the fire, as taught in barrage drill.
- (iii.) To see that the correct elevation and direction are *placed and maintained* on his gun.
- (iv.) To watch for signals from the officer controlling the fire.
- (v.) In the event of a barrage not on the chart being ordered, to see that the correct fire order is passed down, and that his gun is correctly laid before reporting "No. — gun ready to fire."

These duties can only be performed *in toto* when the tactical situation permits. It will often be impossible to prepare elaborate fighting maps and charts owing to lack of time.

#### NUMBERING OF BATTERIES.

Batteries are lettered from the right, A, B, C, etc., throughout the Corps front. In the case of a forward move these become A2, B2, C2, etc., for the first move; A3, B3, C3, etc., for the second move, and so on.



## Tangent Elevation, Angles of Descent, Dimensions of Cones and Zones, &amp;c.

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1	2	3		4	5				6	
Range Yards	Tangent Elevation : Degrees and Minutes.	Slope of Descent		Height in yards of lowest shot below cr. of cone	Dimensions in yards of horizontal beaten zones				Dimensions of cones in yards	
		In Minutes	As a Gradient		Width		Length		Width 75 %	Height 75 %
					75 %	90 %	75 %	90 %		
	° m.									
100	3	—	—	—	—	—	—	—	—	—
200	7	—	—	7	3	—	—	—	3	—
300	11	—	—	10	5	—	—	—	5	—
400	16	15	One in 229	13	7	—	—	—	7	—
500	22	23	„ 149	17	8	2'3	220	700	8	1'5
600	28	32	„ 107	20	10	2'8	204	600	10	1'9
700	35	42	„ 82	23	12	3'3	188	525	12	2'3
800	43	54	„ 64	27	13	3'8	172	450	13	2'7
900	52	69	„ 50	30	15	4'3	156	375	15	3'1
1000	1 2	88	„ 39	33	17	5'0	140	300	17	3'6
1100	1 13	111	„ 31	40	20	6'0	126	270	20	4'1
1200	1 26	139	„ 25	47	23	7'0	112	240	23	4'5
1300	1 41	172	„ 20	53	27	8'0	98	210	27	4'9
1400	1 57	209	„ 16	60	30	9'0	84	180	30	5'2
1500	2 15	251	„ 14	67	33	10'0	75	160	33	5'4
1600	2 35	298	„ 12	73	40	11'3	70	150	40	5'8
1700	2 57	350	„ 9'8	80	47	12'7	70	145	47	7'2
1800	3 21	407	„ 8'5	87	53	14'0	70	140	53	8'3
1900	3 47	469	„ 7'3	93	60	15'3	70	135	60	9'6
2000	4 16	541	„ 6'4	100	67	16'7	70	130	67	10'9
2100	4 48	623	„ 5'5	133	80	18'0	74	140	80	13'4
2200	5 22	715	„ 4'8	167	93	19'3	78	150	93	16'2
2300	6 0	817	„ 4'2	200	107	20'7	82	160	107	19'5
2400	6 41	929	„ 3'7	250	120	22'0	86	170	120	23'2
2500	7 27	1052	„ 3'3	300	133	23'3	90	180	133	27'2
2600	8 16	1186	„ 2'9	350	167	25'0	100	190	167	34'5
2700	9 11	1332	„ 2'6	417	200	26'7	110	200	200	42'3
2800	10 10	1491	„ 2'3	483	233	28'3	120	210	233	52'1



TABLE 2 (A). TRAJECTORY TABLE. .303 VICKERS GUN, MARK VII AMMUNITION.

Angle of Tangent Elevation Minutes	RANGE YARDS	POINT DISTANT FROM GUN IN YARDS.																		
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
3	0	4	1'0	1'9	3'2	4'9	7'1	10'0	13'6	18'0	23'4	30'0	38'2	47'6	58'9	72'1	87'5	105	125	149
7	100	2	7	1'5	2'8	4'4	6'5	9'3	12'8	17'2	22'4	28'9	37'0	46'4	57'0	70'7	86'0	104	124	147
11	200	0	4	1'1	2'2	3'7	5'7	8'4	11'8	16'0	21'1	27'6	35'5	44'8	55'9	68'9	84'0	102	121	145
16	300	3	0	6	1'6	3'0	4'9	7'5	10'7	14'8	19'8	26'2	34'0	43'1	54'5	67'0	81'6	99'5	119	142
22	400	5	5	0	9	2'1	3'9	6'3	9'5	13'3	18'3	24'4	32'1	41'0	52'0	64'4	79'6	96'8	117	140
	500	9	9	6	0	1'1	2'6	4'9	7'9	11'6	16'3	22'3	29'9	38'6	49'2	61'4	76'6	93'6	113	136
28	600	1'2	1'4	1'3	9	0	1'4	3'5	6'3	9'8	14'4	20'2	27'6	36'1	46'6	59'0	73'6	90'6	110	133
35	700	1'6	2'0	2'1	1'9	1'2	0	1'9	4'5	7'9	12'2	17'8	25'0	33'3	43'6	55'8	70'1	87'0	106	128
43	800	2'1	2'7	3'1	3'1	2'6	1'6	0	2'4	5'5	9'6	15'0	21'9	30'0	40'1	52'0	66'1	82'7	102	124
52	900	2'6	3'5	4'1	4'4	4'2	3'5	2'0	0	2'9	6'7	11'9	18'5	26'4	36'2	48'0	61'7	78'0	96'6	119
62	1000	3'2	4'3	5'3	5'8	5'9	5'5	4'4	2'6	0	3'5	8'7	14'7	22'4	31'8	43'2	56'9	72'8	91'1	113
73	1100	3'9	5'4	6'6	7'5	7'9	7'8	7'1	5'6	3'3	0	4'5	10'6	17'9	27'0	38'2	51'4	67'0	85'0	106
86	1200	4'6	6'5	8'1	9'3	10'2	10'3	10'1	9'0	7'1	4'2	0	5'7	12'6	21'4	32'1	45'0	60'1	78'0	98'9
101	1300	5'5	7'8	9'5	11'5	12'7	13'4	13'5	12'8	11'3	8'6	5'1	0	6'5	14'8	25'1	37'5	52'3	69'5	90'0
117	1400	6'4	9'2	11'7	13'8	15'5	16'7	17'2	17'0	16'0	13'9	10'6	6'0	0	7'9	17'7	29'6	43'9	60'7	80'8
135	1500	7'3	10'7	13'7	16'3	18'7	20'3	21'3	21'7	21'9	19'7	17'0	12'7	7'3	0	9'3	20'7	34'6	50'8	70'4
155	1600	8'7	12'7	16'0	19'3	22'0	24'3	26'0	27'0	27'0	26'0	24'0	20'4	15'3	8'7	0	10'9	24'1	39'7	58'6
177	1700	10'0	14'3	18'7	22'7	26'0	29'0	31'3	32'7	33'3	33'0	31'7	28'7	24'3	18'3	10'0	0	12'6	27'6	45'9
201	1800	11'3	16'7	21'3	26'0	30'3	33'8	36'7	39'0	40'3	40'7	40'0	37'7	34'3	28'7	21'3	12'0	0	14'3	32'0
227	1900	13'0	19'0	24'7	30'0	35'0	39'1	43'0	45'0	45'3	45'3	43'3	40'3	37'7	30'7	23'0	15'0	0	16'8	
256	2000	14'3	21'3	27'7	34'0	39'7	45'0	49'7	53'3	56'7	58'3	59'3	58'7	56'7	53'0	47'3	39'3	29'0	16'0	0
288	2100	16'3	24'3	31'7	38'7	45'3	51'7	57'0	62'0	65'7	68'7	70'7	70'7	69'8	66'7	62'0	54'7	45'7	33'7	18'7
322	2200	18'3	27'3	35'7	43'7	51'3	58'7	65'0	70'7	75'7	80'0	82'7	83'7	83'7	81'7	77'7	71'7	63'3	52'3	38'3
360	2300	20'7	30'7	40'0	49'3	58'3	66'3	74'0	80'7	86'3	92'0	96'0	98'0	99'0	98'3	95'7	90'7	83'3	73'7	60'7
401	2400	23'0	34'0	45'0	55'3	65'3	74'7	83'3	91'7	99'0	105	110	114	116	116	115	111	105	96'0	84'3
447	2500	25'7	38'0	50'0	62'0	73'3	84'0	94'3	104	112	120	126	131	135	136	136	134	129	121	111
496	2600	28'7	42'7	56'3	69'3	82'3	94'3	106	117	127	136	144	150	155	158	159	158	155	149	140
551	2700	32'3	47'7	62'7	77'7	92'0	106	119	132	143	153	163	171	178	182	185	186	184	180	172
610	2800	35'3	52'7	69'7	86'3	102	118	133	147	161	173	184	194	202	209	213	215	215	212	207
	L.S.	7	1'0	1'3	1'7	2'0	2.3	2'7	3'0	3'3	4'0	4'7	5'3	6'0	6'7	7'3	8'0	8'7	9'3	10'0
Clearance (yds.)		11	11	11	11	11	13	15	17	20	23	27	31	35	40	46	53	60	69	80

## NOTES.

The table is divided into two parts, one below the zero line and the other above. That part below the zero line is the ordinary trajectory table; that part above and the words "positive" and "negative" are for use when determining clearance in Indirect Overhead Fire. See Section 6, Notes para. vii.

## PART BELOW ZERO LINE.

1.—This table gives at any distance from the gun the height in yards of the centre of the cone ABOVE the line of sight. When used for clearance, line of sight is taken to be horizontal.

EXAMPLE.—At a range of 1900 yards, and at a distance of 1000 yards from the gun the centre of the cone is 48.3 yards above the line of sight.

2.—To find the height of the lowest shot above the line of sight SUBTRACT the figure in the line marked L.S. from the height of the trajectory.

EXAMPLE.—At a range of 1800 yards the lowest shot at 900 yards from the gun is  $39 - 3 = 36$  yards above the line of sight.

## PART ABOVE ZERO LINE.

1.—This table gives at any distance from the gun the depth in yards of the centre of the cone BELOW a horizontal plane passing through the gun position. When using this table the range is not the range to the target, but is the quadrant angle on the gun converted to a range by Table 1, column 2.

EXAMPLE.—At a range of 800 yards, and at a distance of 1200 yards from the gun the centre of the cone is 15 yards below the horizontal plane through the gun position.

2.—To find the height of the lowest shot below the horizontal plane passing through the gun position ADD the figure in the line L.S. to the depth of the trajectory.

EXAMPLE.—At a range of 800 yards, the lowest shot at 1400 yards from the gun is  $30 \text{ plus } 6 = 36$  yards below the horizontal plane through the gun position.

	2100	2200	2300	2400	2500	2600	2700	2800
0	—	—	—	—	—	—	—	—
20'7	0	—	—	—	—	—	—	—
44'0	24'0	0	—	—	—	—	—	—
69'0	50'7	27'3	0	—	—	—	—	—
97'0	79'7	58'0	31'7	0	—	—	—	—
127	111	91'0	66'3	35'3	0	—	—	—
161	147	128	105	75'7	41'7	0	—	—
197	185	168	146	119	86'0	46'3	0	—
13.3	16'7	20'0	25'0	30'0	35'0	41'7	—	—



TABLE 2 (B). Trajectory Table for Negative Quadrant Angles.

Q.E. mins.	POINT DISTANT FROM GUN IN YARDS.																
	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
-5	7	9	1'0	1'2	1'3	1'4	1'6	1'7	1'9	2'0	2'1	2'3	2'5	2'6	2'7	2'9	
-10	3'2	4'9	7'1	10'0	13'6	18'0	23'4	30'0	38'2	47'6	58'9	72'1	87'5	105	125	149	
-25	6'8	9'2	12'2	15'8	20'2	25'3	31'7	39'1	47'6	57'6	69'7	83'7	99'6	118	139	163	
-50	10'4	13'6	17'3	21'6	26'7	32'6	39'7	47'8	57'1	67'8	80'6	95'5	112	131	153	178	
-75	14'1	17'9	22'4	27'4	33'2	39'8	47'8	56'5	66'6	78'0	91'6	107	124	144	167	192	
-100	17'7	22'3	27'6	33'2	39'8	47'2	55'6	65'4	76'0	88'4	102	119	137	158	180	207	
-125	21'3	26'8	32'7	38'0	46'4	54'5	63'6	74'0	85'5	98'5	113	130	149	171	194	221	
-150	24'9	31'1	37'8	44'7	52'9	61'6	71'6	82'8	95'0	109	124	142	162	184	208	236	
-175	28'5	35'4	42'9	50'5	59'5	68'9	79'6	91'5	104	119	135	154	174	197	222	250	
-200	32'2	39'7	47'8	56'4	66'1	76'1	87'6	100	114	129	146	164	186	210	236	265	
-225	35'6	44'1	52'9	62'2	72'7	83'4	95'6	109	123	139	157	177	199	223	250	279	
-250	39'5	48'4	58'2	68'0	79'0	90'7	104	118	133	149	168	188	211	236	264	294	
-275	42'8	52'8	63'3	73'8	85'6	98'0	112	126	142	159	179	200	224	249	277	308	
-300	46'8	57'1	68'4	79'6	92'1	105	120	135	152	169	190	211	236	262	291	323	
-325	50'0	61'5	73'2	85'4	98'6	113	128	144	161	180	201	223	248	275	305		
-350	54'1	65'8	78'3	91'2	105	120	136	152	171	190	212	235	261	288			
-375	57'2	70'2	83'4	97'0	112	127	144	161	180	200	223	246					
-400	61'3	74'5	88'5	103	118	134	152	170	189	210	234						
-425	65'0	78'9	93'6	109	125	142	160	179	199	220	244						
-450	68'6	83'2	98'7	115	131	149	168	189	208	230	255						
-475	72'2	87'6	104	120	138	156	176	196	218	240							
-500	75'9	92'1	109	126	145	163	184	205	227								
-525	79'5	96'5	114	132	151	170											
-550	83'1	101	119	138	158	178											

NOTES.

1.—This table gives at any distance from the gun the depth in YARDS of the centre shot of the cone below a horizontal plane passing through the gun position.

2.—It is for use when determining clearance over our own troops heads in indirect overhead fire, see Section 6.

3.—The line Q.E. —5 means that at 1000 yards for instance, each addition of —5 minutes to the Q.E. adds 1'4 yards to the depth of the trajectory.

EXAMPLE.

Q.E. = —265 minutes; range = 1400 yards. Trajectory depth below horizontal plane = 149 plus ( $\frac{1}{8} \times 2$ ) = 155.

TABLE 3 (A).

## The Quadrant Angle in Minutes, knowing Range and V.I.

303 VICKERS GUN, MARK VII AMMUNITION.

Nov. 1917.

V.I. IN YARDS	RANGE TO TARGET IN YARDS.																											
	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800				
1	7	6	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
5	56	57	60	65	71	79	89	100	114	129	147	166	187	211	236	265	296	330	368	408	454	503	557	616				
10	91	85	84	86	90	96	104	115	127	142	158	177	197	220	245	273	304	338	375	415	461	509	564	622				
15	125	114	109	108	109	114	120	129	141	154	169	187	207	230	254	282	313	345	382	423	468	516	570	628				
20	160	143	133	129	129	131	136	143	154	166	181	198	218	239	263	290	321	353	390	430	475	522	577	635				
25	194	171	158	151	148	148	151	158	167	178	192	209	228	249	272	299	329	361	397	437	481	529	583	641				
30	228	200	183	172	167	165	167	172	181	191	204	220	238	258	281	308	337	369	405	444	488	536	589	647				
35	263	229	207	194	186	183	183	186	194	203	215	230	248	268	291	316	345	377	412	451	495	542	596	653				
40	297	258	232	215	205	200	198	201	207	215	227	241	258	278	300	325	354	385	420	458	502	549	602	659				
45	332	286	256	237	224	217	214	215	220	228	238	252	268	287	309	334	362	392	427	465	509	556	608	665				
50	366	315	281	258	243	234	229	229	233	240	250	263	278	297	318	342	370	400	435	473	516	562	615	672				
55	400	344	305	279	262	251	245	244	247	252	261	273	288	306	327	351	378	408	442	480	523	569	621	678				
60	435	372	330	301	281	268	261	258	260	265	273	284	299	316	336	359	386	416	450	487	530	576	628	684				
65	469	400	354	323	300	285	276	272	273	277	284	295	309	325	345	368	394	424	457	494	537	582	634	690				
70	503	429	379	344	319	303	292	287	286	289	296	306	319	335	353	376	402	432	465	501	544	589	640	696				
75	538	458	403	366	338	320	307	302	300	302	307	316	329	344	362	385	411	440	472	509	550	596	646	703				
80	572	486	428	387	358	337	323	317	313	314	319	327	339	354	372	394	419	448	480	516	557	603	652	709				
85	606	515	452	408	377	354	339	331	327	327	330	338	349	363	381	403	427	456	487	523	564	609	659	715				
90	641	544	477	429	396	371	354	346	340	339	342	348	359	373	390	411	436	464	495	530	571	616	665	721				
95	675	572	502	451	415	389	370	360	353	351	353	359	369	383	399	420	444	471	502	538	577	622	671	727				
100	708	602	526	472	434	406	386	375	366	363	364	370	379	392	408	429	452	479	510	545	584	629	678	733				

## NOTES.

- 1.—This table combines the angle of sight with the angle of tangent elevation, thereby producing the angle of quadrant elevation directly.
- 2.—It is used as follows:—Range = 1900 yards. Target 55 yards above gun. Q.E. = 327 minutes.
- 3.—The top line where V.I. = 1 yard is used as follows:—EXAMPLE 1: Range = 1900, V.I. = 57 yards. The Q.E. for range = 1900 and V.I. = 55, is 327 minutes. For each extra yard of V.I. the top line shows that 2 minutes must be ADDED. Therefore necessary angle of Q.E. is 327 plus (2 x 2) = 331 minutes.



TABLE 3 (B).

## The Quadrant Angle in Minutes, knowing Range and V.I.

303 VICKERS GUN, MARK VII AMMUNITION.

Nov. 1917.

V.I. IN YARDS	RANGE TO TARGET IN YARDS.																											
	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800				
1	7	6	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
5	-12	-1	10	21	33	45	57	72	88	105	123	144	167	191	218	248	280	314	352	394	440	489	545	604				
10	-47	-29	-14	0	14	28	42	57	75	92	112	133	157	182	209	239	272	306	345	387	433	483	538	598				
15	-81	-58	-39	-22	-5	10	26	43	61	80	101	123	147	172	200	230	263	299	338	379	426	476	532	592				
20	-116	-87	-64	-43	-25	-7	10	29	48	68	89	112	136	163	191	222	254	291	330	372	420	470	525	585				
25	-150	-115	-88	-65	-44	-24	-5	14	35	56	78	101	126	153	182	213	247	283	323	365	413	463	519	579				
30	-184	-144	-113	-86	-63	-41	-21	0	21	43	66	90	116	144	173	204	239	275	315	358	406	456	513	573				
35	-219	-173	-137	-108	-82	-59	-37	-14	8	31	55	80	106	134	164	196	231	267	308	351	399	450	506	567				
40	-253	-202	-162	-129	-101	-76	-52	-29	-5	19	43	69	96	124	155	187	222	259	300	344	392	443	500	561				
45	-288	-230	-186	-151	-120	-93	-68	-43	-18	6	32	58	86	115	146	178	214	252	293	336	385	436	494	555				
50	-322	-259	-211	-172	-139	-110	-83	-57	-31	-6	20	47	76	105	137	170	206	244	285	329	378	430	487	548				
55	-357	-288	-235	-193	-158	-127	-99	-72	-45	-18	9	37	66	96	128	161	198	236	278	322	371	423	481	542				
60	-391	-316	-260	-215	-177	-144	-115	-86	-58	-31	-3	26	55	86	119	153	189	228	270	315	364	416	474	536				
65	-425	-344	-284	-237	-197	-161	-130	-100	-71	-43	-14	15	45	77	110	144	181	220	263	308	358	410	468	530				
70	-460	-372	-309	-258	-216	-179	-146	-115	-84	-55	-26	5	35	67	101	136	173	212	255	301	351	403	462	524				
75	-495	-401	-333	-280	-235	-196	-161	-129	-97	-67	-37	-6	25	57	92	128	166	206	248	294	344	397	456	518				
80	-529	-430	-358	-301	-254	-214	-177	-144	-111	-79	-48	-17	15	48	82	119	158	199	240	287	337	391	449	512				
85	-563	-459	-382	-323	-273	-231	-192	-158	-124	-92	-60	-28	5	38	73	111	149	191	233	280	330	384	443	506				
90	-598	-488	-407	-344	-292	-248	-208	-172	-137	-104	-71	-39	-5	29	64	102	141	183	225	273	323	378	436	500				
95	-632	-517	-431	-366	-311	-265	-223	-186	-150	-117	-83	-50	-15	19	55	93	132	175	218	266	316	371	430	494				
100	-666	-545	-456	-387	-330	-282	-239	-200	-163	-129	-94	-60	-25	10	46	85	124	167	210	259	310	365	424	488				

## NOTES.

1. This table combines the angle of sight with the angle of tangent elevation, thereby producing the angle of quadrant elevation directly.
2. It is used as follows:—Range=1900 yards. Target 55 yards below gun. Q.E.=128 minutes.
3. The top line where V.I.=1 yard is used as follows:—EXAMPLE I: Range=1900 yards. Target 57 yards below gun. The Q.E. for range=1900 and V.I.=55, is 128 minutes. For each extra yard of V.I. the top line shows that 2 minutes must be SUBTRACTED. Therefore Q.E. necessary is 128—(2 x 2)=124 minutes. EXAMPLE II: Range=1300 yards V.I.=38 yards; Q.E.=8—(3 x 3)=—1 minute. EXAMPLE III: Range=1100 yards V.I.=47 yards; Q.E.=—68—(2 x 3)=—74 minutes.

TABLE 4.

## WIND ALLOWANCES.

The following is the usual table for rough guidance :—

RANGE IN YARDS	LATERAL ALLOWANCES.					
	MILD 10 m.p.h.		FRESH 20 m.p.h.		STRONG 30 m.p.h.	
	Yards	Minutes	Yards	Minutes	Yards	Minutes
500	1	5	1½	10	2	15
1000	3	10	6	20	9	30
1500	6	15	12	30	18	45
2000	12	20	24	40	36	60
2500	24	30	48	60	72	90

## NOTES.

(i.) The table is for right angle winds; halve the allowances for oblique winds.

(ii.) The minutes of angle can be measured with the "Graticule Card" in order to obtain an auxiliary aiming mark on which to order the gunner to lay.

(iii.) When no clearly defined auxiliary mark is obtainable the lateral angular allowance may be put on by the direction dial, if the angle is reasonably large. If not, the following rough rule for ranges over 500 yards may prove of value :—

Assume the following factors :—Mild, 2; Fresh, 3; Strong, 4; then multiply the range by the appropriate factor, and the first figure of the answer gives the taps required. Thus fresh wind at 1,500 yards;  $1500 \times 3 = 4,500$ ; 4 taps are necessary.

(iv.) The deflection due to drift is negligible below 1,000 yards. At 1,500 yards it is about 2 yards. Above 1,500 yards it is unknown but is certainly several yards at extreme ranges. Drift is to the left.



TABLE 5 (A).—ABBREVIATED TABLE OF ALLOWANCES FOR ATMOSPHERIC INFLUENCES.

(See next page for full table.)

MORE ELEVATION.		LESS ELEVATION.	
Cold (40° Fahrenheit or less) Strong Head Wind Extreme Dryness		Heat (80° Fahrenheit or more) Strong Rear Wind Rain Over 3000 feet above sea	
ALLOWANCES IN YARDS OF RANGE.			
RANGE.	1 FACTOR.	2 FACTORS	
1,000 yards	—	50	
1,500 "	50	100	
2,000 "	100	150	

NOTES.

- (i.) Due to the effect of light on the human eye, *more* elevation must be given in a very bright light and *less* elevation in a very poor light.
- (ii.) Factors affecting elevation in opposite directions will naturally cancel out; the result of combined factors only must be used in the allowance table.
- (iii.) Less elevation is required when firing up or down hill. This may be neglected when the angle of sight to the target does not exceed 10°.

TABLE 6.  
TIME OF FLIGHT.

Total time of flight in seconds.	Distance covered in yards.
1	600
2	1000
3	1300 <sup>3</sup>
4	1550
5	1775
6	1950
7	2100
8	2225
9	2350
10	2450
11	2550
12	2625
13	2700
14	2775
15	2840

**TABLE 5. (B)**  
**ALLOWANCES FOR ATMOSPHERIC CONDITIONS** (for Indirect Overhead Fire, etc.)

ACTUAL RANGE		1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	ACTUAL RANGE		
THER- MOMETER BELOW 60° F. Add.	Temperature (Fah.)	0°	50	75	75	75	75	100	100	100	100	125	125	125	125	150	150	150	150	150	175	120°	THERMOMETER ABOVE 60° F. Deduct.
		10°	50	50	50	75	75	75	75	100	100	100	100	100	100	125	125	125	125	125	150	110°	
		20°	50	50	50	50	50	50	75	75	75	75	75	75	75	100	100	100	100	100	100	100°	
		30°	25	25	25	50	50	50	50	50	50	50	50	50	75	75	75	75	75	75	75	90°	
		40°	25	25	25	25	25	25	25	25	25	50	50	50	50	50	50	50	50	50	50	80°	
		50°	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	70°	
HEAD WIND. Add.	Miles per hour	30	25	25	50	50	50	50	75	75	75	100	100	125	125	150	150	175	200	200	30	REAR WIND. Deduct.	
		20	25	25	25	25	25	50	50	50	50	50	75	75	75	100	100	125	125	150	20		
		10	0	0	0	0	25	25	25	25	25	25	25	50	50	50	50	50	75	75	10		
BAROMETER ABOVE 30" Add.		30.5"	—	—	—	—	—	—	25	25	25	25	25	25	25	25	25	25	25	25	29.5"	BAROMETER BELOW 30" Deduct.	
		31.0"	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	50	50	50	29.0"		

NOTES.—1. Normal atmospheric conditions are (i.) Still air, (ii.) Temperature 60° F., (iii.) Barometer 30". 2. This table saves all calculations, and is correct to the nearest 25 yards.  
3. Halve oblique winds, and thus get the equivalent head or rear wind.

EXAMPLE:—Actual range = 2400 yards. Look down column under this figure. Suppose the thermometer stands at 40°, it will be necessary to add 50 yards to the range, making 2450 yards. Suppose a head wind is blowing at 20 M.P.H., it will be necessary to add another 100 yards, making 2550. Finally, if the barometer stands at 29.0", it will be necessary to deduct 25 yards, leaving a final corrected range of 2525 yards.

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TABLE 7.

## SEARCHING REVERSE SLOPES.

303 VICKERS GUN. MARK VII. AMMUNITION.

1	2	3	4	5	6	7	8	9	10	11	12	Gun Above or Below Crest, yds.	12	11	10	9	8	7	6	5	4	3	2	1
1500	1600	1650	1700	1850	1850	1900	1950	2000	2000	2050	2100		1900	1800	1700	1600	1500	1400	1400	1350	1300	1300	1300	1200
1350	1400	1500	1600	1650	1700	1800	1850	1900	1950	2000	2050	0	2050	2000	1950	1900	1850	1800	1700	1650	1600	1500	1400	1350
1400	1450	1550	1600	1700	1750	1800	1850	1900	1950	2000	2050	10	2000	1950	1900	1850	1800	1750	1650	1600	1550	1450	1300	1150
1450	1500	1550	1650	1700	1750	1850	1900	1950	2000	2050	2100	20	2000	1950	1850	1800	1700	1650	1600	1550	1450	1350	1200	
1500	1500	1600	1650	1750	1800	1850	1900	1950	2000	2050	2100	30	1950	1900	1850	1750	1650	1600	1550	1500	1400	1250	1100	
1500	1550	1650	1700	1750	1800	1900	1950	1950	2000	2050	2100	40	1900	1850	1800	1700	1600	1500	1450	1450	1300	1150		
1550	1600	1700	1700	1800	1850	1900	1950	2000	2050	2100	2100	50	1900	1850	1750	1650	1550	1450	1400	1350	1200			
1600	1650	1700	1750	1800	1850	1950	2000	2000	2050	2100	2150	60	1850	1800	1700	1600	1450	1400	1350	1300				
1650	1650	1750	1750	1850	1900	1950	2000	2050	2100	2150	2150	70	1800	1750	1650	1550	1400	1300	1300	1200				
1650	1700	1800	1800	1850	1900	1950	2000	2050	2100	2150	2150	80	1750	1750	1650	1500	1350	1250	1250					
1700	1750	1800	1800	1900	1950	2000	2050	2050	2100	2150	2200	90	1750	1700	1600	1450	1250	1150						
1750	1800	1850	1850	1950	1950	2000	2050	2100	2150	2200	2200	100	1700	1650	1550	1400	1200	1100						
1800	1850	1900	1900	1950	2000	2050	2100	2100	2150	2200	2200	110	1650	1600	1500	1350	1150							
1850	1850	1900	1950	2000	2000	2050	2100	2100	2150	2200	2200	120	1600	1550	1450	1300	1100							
1850	1900	1950	1950	2000	2050	2050	2100	2150	2200	2250	2250	130	1600	1550	1450	1250								
1900	1950	1950	2000	2050	2050	2100	2150	2150	2200	2250	2250	140	1550	1500	1400	1200								
1900	2000	2000	2050	2050	2100	2100	2150	2150	2200	2250	2250	150	1500	1450	1350	1150								
1950	2000	2050	2050	2100	2100	2150	2200	2200	2250	2250	2300	160	1450	1400	1300									
2000	2050	2050	2100	2150	2150	2150	2200	2200	2250	2300	2300	170	1400	1350	1250									
2050	2050	2100	2100	2150	2150	2200	2200	2250	2250	2300	2300	180	1400	1350										
2050	2100	2100	2150	2150	2200	2200	2250	2250	2300	2300	2350	190	1350	1300										
2100	2100	2150	2150	2200	2200	2250	2250	2250	2300	2350	2350	200	1300											

All Figures represent Yards.

## NOTES.

(1). The top horizontal line is the drop IN YARDS in the first 100 yards beyond the crest. The horizontal line directly below it is the distance to measure back from the crest to find gun position. NOTE: The crest may be taken as being either the highest point of the ground, or, as in the case of a flat-topped hill, the point at which a gentle slope changes to a more abrupt one.

(2). For full explanation of use of Table, see Section 8, Chap. I.

EXAMPLE.—The ground drops 7 yards in 100, and assume also that the gun is below the crest. The left-hand side of table must therefore be used. The table shows that for a drop of 7 yards we must measure back 1900 yards from the crest. At this point, say, the position is found to be 90 yards below the crest. Final range, therefore, equals 2000 yards. Place the gun not nearer to the crest than this point.

(3). When the gun is in position, fire should be directed on the crest, elevation and direction being put on by any of the usual methods for indirect fire. In the example given above, the quadrant angle is that for a V.L. of 90 yards and a range of 2,000 yards—i.e., 411 minutes. See Table 3 (A).

(4). Searching should be employed away from the crest, but it must be remembered that as the cone is beating falling ground the length of the zone will be much increased: therefore the turns of the wheel should be few in number.

(5). If the final position is not suitable the gun should be moved further away from—not nearer to—the crest.

(6). If it be desired to engage an area of ground which lies some distance back from the crest, without searching back from the crest itself, the position of the gun must be determined with reference to the crest as detailed above. Then the quadrant elevation necessary to hit the near limit of the ground to be searched, must be put on in the usual way for indirect fire.

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TABLE 8. INFLUENCE OF GROUND UPON BEATEN ZONES.

For explanation of this Table see Chapter I, Section I, Para. 9.

*Table for Calculating the Reduction (or Increase) of a Beaten Zone falling upon a Near (or Reverse) Slope.*

Range in Yards.		600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	
GRADIENT OF GROUND.	Near Slope.	1/8.5	.07	.12	.18	.28	.38	.46	.54	.61	.68	.74	.79	.82
		1/12	.10	.16	.26	.36	.47	.54	.61	.68	.75	.80	.83	.86
		1/20	.16	.21	.32	.46	.59	.67	.72	.78	.83	.87	.89	.91
		1/50	.3	.40	.56	.67	.76	.82	.86	.91	.94	.95	.96	.96
		1/100	.48	.61	.73	.8	.85	.89	.92	.94	.95	.96	.97	.98
		FLAT	1	1	1	1	1	1	1	1	1	1	1	1
	Reverse Slope.	1/100	*	*	1.60	1.30	1.20	1.13	1.09	1.07	1.05	1.04	1.03	1.02
		1/50	...	...	*	*	1.50	1.33	1.22	1.16	1.13	1.09	1.07	1.06
		1/20	...	...	...	...	*	*	1.74	1.45	1.32	1.22	1.17	1.12
		1/12	...	...	...	...	...	...	*	2.13	1.67	1.42	1.28	1.22
		1/8.5	...	...	...	...	...	...	...	*	2.22	1.81	1.45	1.34

\* At these gradients, slight irregularities of ground, etc., render figures of little value. In some cases the lowest shots would never be able to fall on the slope at all.

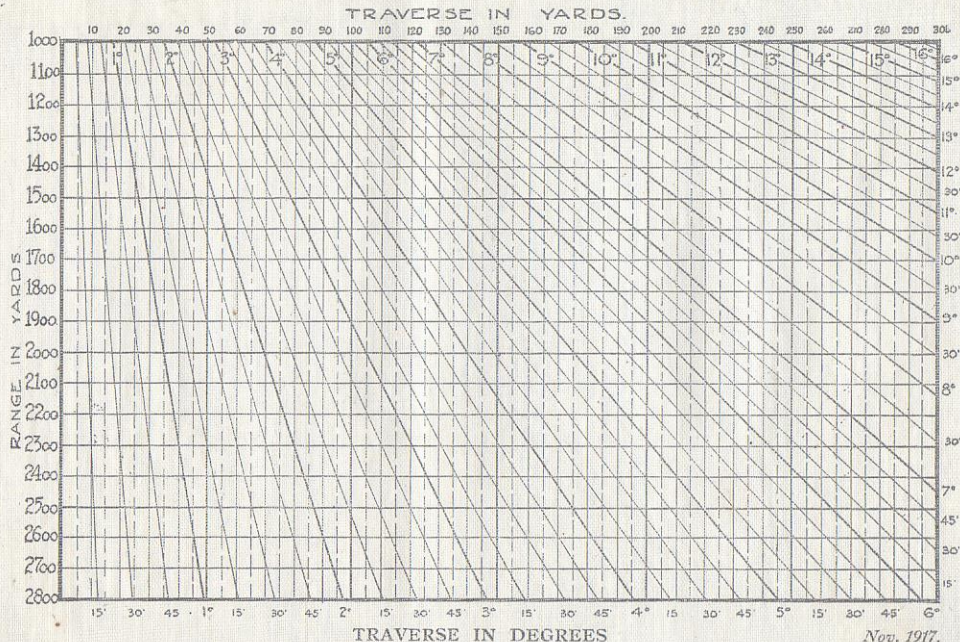
EXAMPLE (NEAR SLOPE):—Range 2000 yards: gradient of near slope on which the shots are falling, is found from the map to be 1 in 20; the 90% B.Z. at 2000 yards is 130 yards long: from the table, the factor in the vertical column under "2000," opposite "near slope  $\frac{1}{20}$ " is 0.78. The B.Z. on the slope will be  $130 \times 0.78 =$  say, 100 yards.

EXAMPLE (REVERSE SLOPE):—Range 2400 yards: gradient of reverse slope  $\frac{1}{12}$ : the E.B.Z. at 2400 yards is 86 yards long: from the table the factor is found to be 1.42: the E.B.Z. on the reverse slope will be  $86 \times 1.42 = 122$  yards long.

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TABLE 9.—GRAPH FOR CALCULATING TRAVERSING ANGLES, &c.



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# APPENDIX II.—FIRE CALCULATIONS FORM (Provisional).

(Indirect, or Indirect Overhead Fire).

For use with Tables in "Infantry Machine Gun Company Training" and "The Machine Gunners' Pocket Book."†

Unit: 390 M.G. Coy.

Date: 22nd May, 1917.

Map Used: 1/10,000, 28 S.W. Sh. 2.

Officer i/c Firing: 2nd Lieut. Y.Z.

		DIRECTION.	ELEVATION.						CLEARANCE OVER OWN TROOPS.				REMARKS.	Checked.	
Gun No. and Map Location	Target and Map Location	Bearing †	Contours		Range to Target	V.I.	Q.E.	Range Yards Corres- ponding to Q.E.	Distance to Own Troops	Contour of Own Troops	Traj. Height	Clearance			
			Gun A	Target						B	C	A - B + C			
1 N. 29. c. 95. 35.	L'ENFER FARM O. 25. d. 85. 80.	90° Magnetic	66 <sup>x</sup>	84 <sup>x</sup>	2500 <sup>x</sup>	18 <sup>x</sup>	472 mins.	2550 <sup>x</sup>	Nearest {	300 <sup>x</sup>	64 <sup>x</sup>	40 <sup>x</sup> Positive	42 <sup>x</sup>	Y. Z.	
		Furthest {							500 <sup>x</sup>	70 <sup>x</sup>	66 <sup>x</sup> Positive	62 <sup>x</sup>			
2 N. 29. c. 95. 35.	TRAMWAY CUTTING O. 19. d. 40. 28.	82° Magnetic	66 <sup>x</sup>	86 <sup>x</sup>	2450 <sup>x</sup>	20 <sup>x</sup>	452 mins.	2500 <sup>x</sup>	Nearest {	300 <sup>x</sup>	68 <sup>x</sup>	38 <sup>x</sup> Positive	36 <sup>x</sup>	Search upwards 1 degree 30 minutes.	Y. Z.
		Furthest {							500 <sup>x</sup>	77 <sup>x</sup>	62 <sup>x</sup> Positive	51 <sup>x</sup>			
									Nearest {						
		Traversing							Furthest {						
									Nearest {						
		Traversing							Furthest {						
									Nearest {						
		Traversing							Furthest {						

NOTES.—† (1) When using the Tables, all measurements must be in yards.

‡ Insert grid, or magnetic as the case may be.

(2) CLEARANCE in yards = A — B plus or minus C according as trajectory tables give positive or negative values of C. (A, B, and C must all be either in metres or in yards.)

(3) IMMEDIATELY before firing Q.E. must be corrected, if necessary, for atmospheric influences. SEE TABLES 5 (A) and 5 (B).

(4) For lateral wind allowance, see TABLE 4.

(5) If obstruction exists between gun and target, and its highest point cannot be seen, ascertain if shots will clear by substituting "obstruction" for "own troops" in clearance columns above, and find clearance by rule in NOTE (2). Minimum clearance required equals half height of cone for distance to obstruction.



# APPENDIX II.

## INDIRECT FIRE CHART.

*Unit*..... *Officer i/c Guns*..... *Map*..... *Date*.....

Gun	Gun Position	Target and Map Location	Time	Bearing †	Q.E.	Traverse	Minimum Clearance	Remarks	Checked by

† Insert Grid or Magnetic as the case may be.

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## CHAPTER II.

### NOTES ON TRENCH ROUTINE FOR MACHINE GUN COMPANIES.

#### FOR GUIDANCE IN FRAMING STANDING ORDERS.

##### 1. AEROPLANES.

(a) Hostile aeroplanes are constantly on the look-out for machine gun works. These should therefore be concealed from view, both during and after construction. It is just as important to conceal an emplacement from the top as from the front or rear.

(b) Aeroplanes should never be engaged from a battle position, but from a position specially prepared for anti-aircraft defence.

##### 2. AMMUNITION.

(a) Ammunition should be obtained under Brigade arrangements. On no account should it be drawn from the mobile reserve in the S.A.A. limbers, except in special circumstances and by direct orders.

(b) The section officer must never allow his stock of S.A.A. to run low. He should notify company headquarters immediately when in need of fresh supplies. Before handing over, on relief, he should ensure that *all* deficiencies are made up. (See also *Depots and Emplacements*).

(c) Empty cases should be collected and sent back periodically.

(d) The daily firing report (see *Returns*) makes it possible to check the amount of ammunition expended, and assess the life of the barrel.

(e) One belt-filling machine should normally be kept at the depot (see *Depot*), the other at company headquarters.

##### 3. CASUALTIES AND SICK.

(a) There should be periodical practices, while in trenches, of first aid and the use of the field dressing.

(b) Wounded in trenches should be sent to the first aid post.

(c) A machine gun company has no medical officer. Arrangements for dealing with sick should be made with the M.O. of the infantry unit occupying the sector.



4. CLEANLINESS.

The same standard of cleanliness should be aimed at as when in billets. As a rule, men should have shaved themselves before a fixed hour every day.

5. CLOTHING AND EQUIPMENT.

Men should be warned that the loss of any article of clothing or equipment will be made the subject of the usual enquiry, and payment exacted if necessary.

6. COOKING AND FIRES.

The O.C. Coy. should ascertain what orders exist as to cooking and fires.

7. DEPOTS.

It is essential that the section officer should have some central depot from which to control his guns.

In trenches, therefore, each machine gun section should establish a *depot* at a convenient radius from the four gun emplacements. This depot, which should be a large shell-proof dug-out, serves as—

- (i.) The section officer's headquarters.
- (ii.) Repository for spare stores and ammunition.
- (iii.) Shelter for spare gun numbers during bombardment.
- (iv.) Belt-filling centre.

8. DISCIPLINE.

In trenches ordinary discipline should not be relaxed. Compliments should be paid as far as possible, and men should stand to attention when addressed by an officer.

9. DRESS IN TRENCHES.

(a) Equipment must always be worn in the front line, without pack; under other conditions according to local orders.

(b) Shrapnel helmets and gum boots should be worn as directed.

(c) Gas appliances will always be carried slung over everything, including greatcoats.

(d) Boots should never be removed in the front line.

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## 10. DUG-OUTS.

Dug-outs should contain the following stores:—

- (a) Ammunition.
- (b) Reserve rations and water. (See *Rations*).
- (c) Anti-gas apparatus, blankets, &c.
- (d) Water for guns.
- (e) Picks and shovels.
- (f) Anti-gas blankets.

NOTE.—When dug-out and emplacement are combined, see also *Emplacements*.

## 11. DUTIES.

(a) *All ranks in a Section must know—*

- (i.) The position of the section depot.
- (ii.) The position of all the section guns.
- (iii.) The shortest route between guns and depot.
- (iv.) The General Defence Scheme.—Each man must know the limits of, and understand the system under which his fire combines with that of other guns.
- (v.) Position of latrines.
- (vi.) Position of first-aid post.
- (vii.) Arrangements for water supply.

(b) *The Machine Gun Company Commander—*

- (i.) Must see that the field of fire of each gun is correctly marked on the trench maps, and that the trench maps are kept up to date.
- (ii.) Will keep the war diary.
- (iii.) Should visit his sections daily, and occasionally at night.
- (iv.) Should establish *personal* relations with the infantry, artillery, R.F.C., and engineers with whom he is co-operating.
- (v.) Should keep in touch with the tactical situation and the plans of the brigade commander, and do his utmost to maintain *continuity* in the general scheme of work.

(c) *Second in Command.*

- (i.) Has general control of administration, and deals with all indents and requisitions for material, ammunition, clothing, etc.
- (ii.) Is responsible for the maintenance of ration supply to the sections in trenches.



- (iii.) Is the understudy of the company commander in all respects, and must be able to assume command of the company at a moment's notice.

(d) *Section Officer.*

- (i.) Should keep the second in command informed of his requirements in the way of material, personnel, ammunition, etc.
- (ii.) Is responsible for the punctual rendering of all necessary returns. (See *Returns.*)
- (iii.) Should draw up a time-table for his section, showing hours of work, stand-to, rest, cleaning guns, etc. Steps will be taken to ensure that all guns are not stripped at the same time.
- (iv.) Must carry out the necessary inspections. (See *Inspections.*)
- (v.) Should fire his guns at least once every 24 hours. If no tactical opportunity presents itself, a few bursts at least should be fired, especially in cold weather, in order to test the mechanism.
- (vi.) Should endeavour to co-operate in every way with local infantry and Lewis gunners.
- (vii.) Should keep a log book. (See *Appendix IV.*)

(e) *Company Sergeant Major.*

- (i.) Should live at Company Headquarters.
- (ii.) Is responsible for the maintenance of good order and efficiency among the non-commissioned officers.
- (iii.) Should frequently accompany the M.G.C.C. on his rounds.
- (iv.) Is responsible for the collection of the daily reports of the section officers.

(f) *Company Quartermaster Sergeant.*

Is responsible for the division and despatch of rations, etc., to the various sections in trenches, under the supervision of the second in command.

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(g) *Section Sergeant.*

- (i.) Will keep a sentry roster.
- (ii.) Is responsible for the condition of all arms.
- (iii.) Will enforce rules as to cleanliness, etc.

(h) *Corporals.*

- (i.) Are responsible for ration parties, drawing materials, and supplies.
- (ii.) Are responsible for the condition of the ammunition and belts.

(i) *Gun Numbers.*

Various routine duties should be allotted to these,  
*e.g. :—*

No. 1	...	...	...	Cleaning of gun.
Nos. 2 and 4	...	...	...	Belts.
No. 3	...	...	...	Spare parts.
Other numbers	...	...	...	Belt-filling.

(j) *Artificer.*

- (i.) Should overhaul every gun at frequent intervals, sending a report on repairs found necessary.
- (ii.) Will arrange for the numbering and marking of emplacements, depots, etc.

12. EMPLACEMENTS. (See also *Dug-outs.*)

(a) Each emplacement or position and dug-out must be plainly marked—MACHINE GUN, NO.....

(b) The emplacement will contain—

- (i.) A trench order board. (See *Appendix I.*)
- (ii.) Range card.
- (iii.) Anti-gas apparatus.
- (iv.) Very pistol and lights.
- (v.) Trench store card.
- (vi.) About half the gun's belt } Remainder at the
- (vii.) 2 or 3 boxes of S.A.A. } section depot.
- (viii.) Grenades.
- (ix.) Periscope.



NOTE.—It is suggested that the periscope should be fixed in the parapet, in a defiladed position, with a field of view corresponding to the field of fire of the gun. Periscope and range card can then be used in conjunction.

(c) *Loopholes* will be tested daily at dawn or dusk, and should occasionally be examined from the outside.

### 13. GUNS AND EQUIPMENT, CARE OF.

(a) *Gun Covers*.—These should always be used when the gun is dismounted, or being carried from one position to another.

(b) *Spare Parts*.—These will be constantly inspected and checked. (See *Inspections*.)

### 14. INSPECTIONS.

The following inspections will be made :—

(a) *Daily*.

- (i.) Guns, ammunition, and spare parts.
- (ii.) Arms and equipment.
- (iii.) Iron rations.
- (iv.) Gas helmets—these should merely be checked, and only be unfolded occasionally. Box respirator drill must be practised at frequent intervals.
- (v.) Field dressing.
- (vi.) Dug-outs and emplacements. Cleanliness and state of repair.
- (vii.) Latrines.
- (viii.) Feet, personally by the section officer. A few men at a time to be relieved for this purpose if tactical situation permits.
- (ix.) All anti-gas apparatus.

(b) *Before and after a tour of duty in trenches*.

- (i.) Boots.
- (ii.) Water bottles.

(c) *Periodically*.

- (i.) Kit.
- (ii.) Breathing sets.—Arrangements will be made with local medical officer for regular inspection.

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## 15. NIGHT LINES.

(a) The quadrant elevation and direction for each target of each gun should be marked on the range card in order to facilitate laying the gun in darkness.

(b) Each gun should be laid at dusk along the line giving the maximum "stopping" fire, so that in case of alarm, fire can be opened immediately without any time being lost in laying.

## 16. RATIONS.

(a) Arrangements for ration supply should conform generally to those of the brigade.

(b) Rations will be drawn by the C.Q.M.S. at the re-filling point, and divided at the transport by the C.Q.M.S., assisted by corporals and storemen.

The C.Q.M.S. should be notified of the exact number of men per section in trenches, and will divide the rations accordingly, and send them up to the appointed dump, where they will be met by ration parties from each section.

(c) Arrangements should be made for storing 3 or 4 days' rations and water in *strong points*, where it is possible that machine gunners may be called upon to make a protracted stand.

## 17. RECREATION.

(a) Every endeavour should be made to supply the men off duty with diversion, in the shape of newspapers, etc.

(b) They should be kept informed of the general progress of the campaign, by having read to them points of interest from the daily official summaries.

## 18. RELIEFS.—(See *Appendix II.*)

## 19. RELATIONS WITH OTHER TROOPS.

Smooth working in trench routine depends upon cordial co-operation with other arms. (See *Appendix III.*)



## 20.—RETURNS, ETC., RENDERED ON ARMY FORMS.

No. of Form.	Description of Form.	When Sent.	To Whom Sent.
A. B. 55	Ration Indent .. .. .	Daily .. .. .	Supply Officer.
B. 213	Strength .. .. .	Weekly, made up to Saturday ..	Brigade.
B. 231	Field Strength .. .. .	Weekly .. .. .	
B. 2069	Offence Report .. .. .	Weekly, by post on Sunday ..	O. i.c. M.G. Section, 3rd Echelon, G.H.Q.
—	Billetting Certificate .. .. .	Weekly, and on leaving billets ..	To Mayor. Duplicate to Branch Requisition Officer.
W. 3401	Billetting Distribution List .. .. .		
B. 158	List of Officers .. .. .	Monthly, before the 4th ..	D.A.G., 3rd Echelon Base.
W. 3447	Claim for Allowances .. .. .	Monthly .. .. .	Command Paymaster, Base.
W. 3383	Officers recommended for promotion to Command or Second in Command.	" .. .. .	Brigade.
C. 2118	War Diary .. .. .	" (Duplicate periodically to M.G. Corps Record Office.)	
N. 1531a	Imprest Account .. .. .	Monthly, at end of month ..	Staff Paymaster i.c. Clearing House.
W. 3069	Charges for Stores issued on repayment ..	" .. .. .	Regimental Paymaster.
W. 3100	Cash Requisition .. .. .	When required .. .. .	Field Cashier.
N. 1513	Acquittance Roll .. .. .	After paying out .. .. .	Staff Paymaster i.c. Clearing House.
		(Duplicate after two months to D.A.R., Deposit Store, A.P.O.S. 39)	
W. 3448	Furlough Pay .. .. .	When required .. .. .	Disbursements Officer, Railhead
W. 3241	Officers' Advances .. .. .	" .. .. .	Field Cashier.
O. 1614	Proficiency Pay Voucher .. .. .	Before Sept. 30th .. .. .	Regimental Paymaster.
W. 3286	Proficiency and Working Pay Claim ..	When required .. .. .	Command Paymaster, Base.
W. 3458	Claim for Bounty on Re-engagement ..	" .. .. .	O. i.c. Records, M.G. Sec., Base
D. 418c	Claim for Separation Allowance (Wife) ..	" .. .. .	Regimental Paymaster.
O. 1838	" " (Dependant) .. .. .	" .. .. .	"
G. 994	Indent for Stores .. .. .	" .. .. .	D.A.D.O.S.
W. 3313	Supplies purchased locally .. .. .	" .. .. .	Requisitioning Officer.
W. 3121	Recommendation for Reward .. .. .	" .. .. .	Brigade.
M.T. 393	Application for Commission .. .. .	" .. .. .	
W. 3190	Certificate of Effects .. .. .	" .. .. .	D.A.D.R.T., Havre.
W. 3300	Label—Sick or Wounded Officers' Kit, addressed to	D.A.D.R.T., Kit Warehouse, Boulogne.	
W. 3301	" Deceased, Missing, or Prisoner, ..	" .. Messrs. Cox's Shipping Agency.	
W. 3042	" Sick or Wounded, Other Ranks, ..	" .. D.A.D.R.T., Havre.	
W. 3043	" Deceased, Missing, or Prisoner, ..	" .. D.A.G., 3rd Echelon.	

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NOTE.—The returns shown on the opposite page are the usual returns, etc., rendered on Army Forms. The list is liable to alteration from time to time by General Routine Orders, and it does not include those returns which are made to Brigade, and for which no special Army Form is issued. Army Forms are obtained on indent from the Army Printing & Stationery Depot attached to the Army in which the Company is for the time being.

#### 21. RUM.

(a) The rum ration will be brought direct to company headquarters. Here it will be divided in the presence of an officer, and sent up to the trenches in charge of the corporals. The corporals are personally responsible for the conveyance of the ration, and will hand the same direct to their section officers.

(b) The rum will be issued and drunk in the presence of an officer.

#### 22. SANITATION.

Orders should be published to conform with sector arrangements.

#### 23. SENTRIES.

*By Day.*—One sentry *over the gun*, ready to open fire at any moment.

*By Night.*—Two sentries, one ready to open fire immediately, the other to wake the remainder of the team.

*Day and Night.*—A sentry at the parapet close by. This man need not necessarily be a machine gunner.

For sentry order board see *Appendix I*.

#### 24. SMOKING AND ELECTRIC TORCHES.

(a) Orders regarding *smoking* should be issued in conformity with brigade orders.

(b) *Electric torches* should be employed with the utmost caution, especially in communication trenches and points behind the front line.

#### 25. STORAGE OF EQUIPMENT.

Spare guns, stores, and equipment should, under normal trench conditions, be stored at company headquarters, and not at the transport.

#### 26. SUBSIDIARY LINES, ETC.

In lines, strong-posts, etc., situated some distance in rear, rules as to "stand-to," sentries, etc., may be modified.

#### 27. TRENCH STORES.

In taking over, the trench stores at each emplacement or dug-out should be checked, and the inventory card signed by the respective gun commanders. (See *Appendix V*.)



28. TRAINING.

Every effort should be made, while in trenches, to prevent staleness among the gun teams by—

- (a) Constant and varied employment.
- (b) Keeping men informed of the tactical situation, showing them trench maps, etc.
- (c) Encouraging men to discover suitable positions for emplacements, and to study the enemy's trench line.
- (d) Varying diet as much as possible. If possible make necessary arrangements with infantry.

29. WATER.

(a) *Drinking Water* is usually brought up to the trenches in petrol tins, and must not be wasted. Arrangements for distribution and storage should be made.

(b) *Washing, and Guns.*—Water for these can frequently be obtained by sinking a small pit in the floor of the trench.

30. WAR DIARY.

See Field Service Regulations, Part II., Sec. 140.

31. WORKING PARTIES.

Machine gunners are responsible for the construction of their own works, but are entitled to apply to the infantry for working and carrying parties and for any R.E. expert assistance required. Application should be made through the brigade headquarters, stating:—

- (i.) Number required of all ranks.
- (ii.) To whom to report, time, place.
- (iii.) If tools are required.
- (iv.) Special points—*e.g.*, whether haversack ration to be brought.
- (v.) Duration of task.

APPENDIX I.

Orders for Sentry and Gun Team Commander at  
No.....Machine Gun Position.

1. Fire is only to be opened by order of the gun commander, unless a sudden emergency arises, in which case the sentry will use his own initiative.

2. When relieving another gun team or sentry, the following facts will always be ascertained:—

- (a) Whether the gun has been fired during the relief.
- (b) If fired, what was the target.
- (c) From what position was it fired.
- (d) Whether any instructions have been received as to friendly patrols or wiring parties.

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- (e) Whether enemy machine guns have been firing in the vicinity; if so, their probable direction.
  - (f) Whether any hostile shelling has occurred near the gun position which might indicate that it had been located by the enemy.
  - (g) Whether there have been any movements of our own or hostile aircraft.
  - (h) Whether any unusual point or sound has been observed.
3. The sentry will always inspect the gun when taking over the position.
  4. The sentry on duty must have an accurate knowledge of the points shown on the range card.
  5. In case of an **ALARM** or **GAS ATTACK** the sentry will wake the gun team immediately.
  6. The gun will not usually be mounted in its position, except during the hours of darkness, or unless the situation renders it advisable.
  7. The gun will be cleaned daily, and the **POINTS BEFORE FIRING** gone through both morning and night. The gun must be kept free from dirt, and in the trenches may be kept wrapped up in a waterproof sheet or bag. Such a covering must not prevent the gun being mounted for action immediately.
  8. Ammunition, spare parts, and anti-gas apparatus will be inspected daily. When the wind is in the "**DANGEROUS**" quarter, the sentry will be responsible that all anti-gas apparatus is in position and in order.
  9. The lock spring will never be left compressed. With the Vickers gun it is generally sufficient to half-load and then press the thumb-piece when mounting the gun at night. In order to open fire, it is only necessary to complete the loading motion and press the thumb-piece.
  10. All dug-outs, emplacements, and ammunition recesses belonging to the gun position must be kept clean and in good repair.

#### SPECIAL ORDERS FOR THIS GUN POSITION.

- 11.
- 12.
- 13.
- 14.

Date.....

.....Machine Gun Officer.

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## APPENDIX II.

### RELIEF OF TRENCHES.

*Taking over Trenches.*—When a line of trenches is about to be taken over by a brigade, the machine gun company commander will go round the whole position with the outgoing machine gun company commander, and observe—

1. The position and field of fire of each gun emplacement, and note whether concrete, steel, sandbag, etc.
2. The position of machine gun dug-outs.
3. The position of all extra emplacements.
4. The position of all splinter-proof look-out posts.
- 5a. The position of the section depots, and the most direct means of access to their guns.
- b. Ration and ammunition dumps.
- c. Water supply.
- d. Medical arrangements.

*He should obtain from this officer—*

6. Details of the general scheme of defence, under which the machine guns co-operate.
7. Particulars of work, etc., in progress, which will require completion.
8. The most suitable time of the day for reliefs.

*When the machine gun teams take over the actual positions, they should extract all possible information from the outgoing teams, e.g. :—*

9. Which of the emplacements have actually been fired from and how recently.
10. Position of enemy machine gun emplacements.
11. Vulnerable spots in own line.
12. Vulnerable spots in the enemy's line.

*Reliefs.*—(A). Reliefs between two machine gun companies.

- (B). Internal reliefs within one machine gun company.

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#### A. RELIEFS BETWEEN TWO MACHINE GUN COMPANIES.

1. On this occasion, the duties of the machine gun company commander are as follows :—

(a) The issue of detailed orders. To effect a relief completely and punctually is a complicated operation.

(b) The provision of transport, from company headquarters to the dumping point.

(c) The provision of a sufficient carrying party to convey the guns, belt boxes and necessary stores from the dumping point to the emplacements. A gun section is incapable of carrying all its equipment at once. If only a certain proportion of the guns are being taken into the line—say half—a carrying party can be organised from the spare sections of the company : if all the guns are to be taken up, outside help must be arranged for.

2. The duties of the section officer are as follows :—

(a) To take over the depot from the outgoing officer, and check all trench stores handed over.

(b) To report to the machine gun company commander (by orderly or telephone), when the relief is complete.

3. The duties of the N.C.O. or gun-number in charge of each gun are as follows :—

(a) To see that nothing is left behind in the limbers, and that everything arrives at the emplacements. He should walk in rear of his party, to see that nothing is dropped or left behind.

(b) To take over and check all trench stores in the emplacement or dug-out (S.A.A., order board, range card, anti-gas appliances, etc.) Receipts should be given in all cases.

(c) To notify the section officer of the completion of the relief.

NOTE.—Officers, N.C.O.'s and gun numbers, upon taking over, should extract all possible information from the outgoing company as to the tactical situation, etc. Orders will often be given for a few men of the outgoing M.G. company to be left in the line with the new company for a short period.

#### B. INTERNAL RELIEFS.

The procedure here is exactly the same as in (A).



APPENDIX III.

RELATIONS WITH OTHER ARMS.

The secret of all successful working between troops of different arms being co-operation and avoidance of jealous action of any kind it is, therefore, necessary to cultivate personal and friendly relations with—

1. THE INFANTRY.

(a) The infantry company commander can be of great assistance and will sometimes supply working parties and other personnel for assistance in the working of machine guns in the trenches.

(b) The nearest infantry sentry may sometimes enable you to avoid using one of your own machine gunners as sentry outside the machine gun emplacement.

(c) The infantry commander is the "officer commanding sector," and it is necessary to consult him to ensure that machine gun arrangements do not clash with his orders.

2. THE ARTILLERY.

The artillery will often—

(a) Allow machine gunners to use their observation posts.

(b) Give valuable help with maps, bearings, errors of the day, etc.

(c) Valuable information as to likely targets behind the enemy line.

3. THE ROYAL ENGINEERS.

The Royal Engineers supply all materials required for field work construction in the trenches, and are always willing to give their technical advice on such subjects, as the building of concrete emplacements and dug-outs. It is advisable to send transport belonging to a machine gun company to collect the material, instead of waiting for it to be delivered. Establish *personal* relations with the Engineers, and avoid confining dealings to indents and official correspondence.

4. BRIGADE HEADQUARTERS.

The brigade commander will expect his machine gun company to be the smartest in appearance and the most efficient in action in the whole division. Be sure that all ranks of the company pay him the necessary compliments.

The brigade major will expect punctuality and

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accuracy in reports, and immediate acknowledgement of, and compliance with all orders.

The staff captain will expect administrative returns to be correct, and all demands for stores and ammunition to be rendered to him punctually.

#### 5. THE ARMY SERVICE CORPS.

The Army Service Corps will be of the greatest assistance in keeping the transport in a high state of efficiency, and is in a position to lend farriers, wheelwrights and saddlers, and give much valuable advice, and will sometimes attach one or two men of the machine gun transport to his company for instruction in various duties.

#### 6. ORDNANCE.

Keep in close personal touch with the D.A.D.O.S., and closely supervise this branch of the quartermaster sergeant's duties.

Above all things, avoid criticism of other arms, and give to them what assistance is in your power.

### APPENDIX IV.

## SAMPLE OF ENTRY IN TRENCH LOG BOOK.

ONE TO BE KEPT BY EACH SECTION.

17—2—16.

2 a.m. Hostile patrol of three men, seen trying to approach wire opposite No. 2 gun, fired from C 2 and patrol driven off.

11 a.m. Enemy put five 4'2 in. high explosive shells into trench near C 3. No damage; evidently attracted by some smoke.

3 p.m. Enemy working party observed near west corner of distillery; dispersed by artillery.

4.30 p.m. Enemy machine gun emplacement located in their parapet at I. 31.C.6.2., when firing at one of our aeroplanes.

#### WORK DONE.

One officers' dug-out finished, and one bomb-proof for three men.

#### WORK SUGGESTED.

Two new emplacements for No. 3 gun. Roof of ammunition depôt requires strengthening.

X.Y. Lieut.,  
Officer commanding No.....Section.  
No.....Machine Gun Company.

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# APPENDIX V.—TRENCH STORE CARD (for handing over). Date ..... (Example).

Chapter II. (continued).

STORES	Quantity on Hand	Quantity Received	TOTAL	Quantity Expended	HOW EXPENDED	Balance	Quantity Required
1. Picks	5	Nil	5	1	Broken during work	4	1
2. Shovels	10	Nil	10	Nil		10	Nil
3. Mauls	1	Nil	1	Nil		1	Nil
4. Hammers	4	Nil	4	Nil		4	Nil
5. Periscopes	6	Nil	6	2	Broken by Sniper	4	2
6. Dug-out Gas Screens	8	Nil	8	Nil		8	
7. Very Pistols	6	Nil	6	Nil		6	Nil
8. " Lights, White (box)	1	1	2	1		1	1 Box
9. " " Red "	1	Nil	1	Nil	Fired		
10. " " Green "	1	Nil	1	Nil			
11. Bombs (Boxes)	8	Nil	8	Nil			
12. Ammunition, '303 (rounds)	14000	6000	20000	6000		14000	Nil
13. Wire, Plain (coils)	32	Nil	32	Nil	etc.	32	Nil
14. " Barbed (coils)							
15. Sandbags	etc.	etc.	etc.	etc.		etc.	etc.
16. Loophole Plates							
17. " Boxes							
18. Corrugated Iron							
19. Pivot Mountings							
20. Ammunition Box Mountings							
*21. Nails							
*22. Spikes							
*23. Uprights							
*24. Beams							
*25. Round Spars							
*26. Expanded Metal							
*27. Rabbit Wire							
*28. Belt Boxes							

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\* These items are not trench stores, but forms a convenient record of material on hand.

# APPENDIX VI.

## EMPLACEMENT OR DUG-OUT INVENTORY BOARD. (*Example.*)

Picks ... ..	5				
Shovels ... ..	10				
Belt Boxes ... ..	7				
Boxes Ammunition ... ..	2				
Mauls ... ..	2				
Periscopes ... ..	4				
Gas Screen ... ..	...				
Bombs ... ..	18				
Ammunition S.A.A. (boxes)...	16				
Very Pistols ... ..	4				
Very Lights (White)...	30				
Very Lights (Green)...	6				
Very Lights (Red) ... ..	6				
And so on ... ..					
<div>Signatures, and date of taking over.</div> <div> A. B. Lieut.  70 M. G. Coy.  17/2/16. </div>					



## APPENDIX VII.

No..... M. G. Company.

## SECTION OFFICER'S FIRING AND TACTICAL SITUATION REPORT.

No..... Section.

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Date	No. of Gun	Position from which Gun Fired	Time	Target	No. of Rounds	Remarks

Write Tactical Report on the back of this Form.

Signed.....

NOTE.—If fire was indirect quote number of Calculation Form in Remarks Column, so that reference may be made to it.

## APPENDIX VIII.

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### CARE OF MACHINE GUNS IN FROSTY WEATHER.

1. Not more than about 5 pints of water should be put into the barrel casing, and 20 per cent. of glycerine will prevent it from freezing quickly. In extremely hard weather, if the gun has to be exposed, experience has proved that  $2\frac{1}{2}$  pints of water plus  $2\frac{1}{2}$  pints of pure or residue glycerine is necessary. A drawback, however, to the large proportion of glycerine is that if fire is sustained until the mixture boils very bad fumes are given off. If the gun is used in a covered emplacement these fumes have more effect upon the team than the fumes given off by cordite.

2. Working parts should be slightly oiled with a lightly oiled rag. If firing is sustained oil must be applied to all frictional parts.

3. Guns should be wrapped in blankets, sandbags, or rope, etc., and kept near braziers or in the men's dug-outs or close to the body till required. If none of these courses are possible, the recoiling portions should be frequently worked, or single shots fired and the lock be changed at intervals, the spare lock being kept in a clean pocket close to the body.

4. A proportion of ammunition should, if possible, be kept warm and changed at intervals.

5. If possible, some oil should be kept warm for use if firing is prolonged.

6. Should the water in the barrel casing become frozen solid, on the gun being fired the barrel will probably not recoil far enough to work the gun and will remain back. To remedy this, pull the crank handle on to the roller, then bring it back to a vertical position and force the barrel to the front, pulling the belt if necessary; let the crank handle return to the check lever and fire the gun. This should be repeated until the barrel recoils correctly.

7. If a gun is exposed in extremely hard weather, fusee and other springs become brittle, and lose their quickness. Fusee springs should be lightened, as the frost tends to increase their weight.



## CHAPTER III.

### Hygiene and First Aid.

#### SECTION I.

#### NOTES ON MILITARY HYGIENE.

##### LECTURES :—

The men should be lectured on the following subjects—

1. Hygiene on the march.
2. „ in barracks or billets.
3. „ in the field.
4. „ in the trench.

The following notes might form a basis for lectures upon—

##### 1. HYGIENE ON THE MARCH.

(a) March discipline—open formation—prohibition of smoking and constant drinking from water bottles.

(b) HALTS.—Easing of packs—detail sanitary police : fix latrines—if practicable : the men should lie down with feet raised, to allow of a more natural circulation.

(c) CARE OF FEET.—Washing—blisters—fitting of boots and socks—treatment of tender parts.

##### 2. HYGIENE IN BARRACKS OR BILLETS.

(a) Rules regarding personal cleanliness and sanitation should be instilled into all men—posted in a conspicuous place in each room—dealing with (a) Common items of toilet. (b) Frequent washing of the body. (c) Expectoration. (d) Tidiness of the room.

(b) LATRINES AND THE ROOM.—The digging of the former and the cleansing of the latter must be the first and last duties before entering and leaving billets. Rooms should be “dry-cleaned” regularly; and when washed, a minimum amount of water should be used to prevent mildew.

(c) Underclothing must be washed once every week ; but if water is scarce, thorough drying and dusting is a simple way of partially cleansing.

(d) Latrines and urinals must be inspected daily by the Orderly Officer—they should be scrupulously clean and disinfected daily with cresol solution, kerosene, or chloride of lime.

(e) Night accommodation must be provided—one urine bucket for each hut.

(f) Sanitary police (1 per section) should be detailed to enforce the observance of all sanitary rules.

### 3. HYGIENE IN THE FIELD.

(a) An advance party before bivouac or encampment should—

- (a) Study the water supply.
- (b) Plan out the sanitary system.
- (c) Investigate and isolate places where disease is prevalent.

(b) A SANITARY SQUAD SHOULD PROVIDE (on arrival)—

- (a) Latrines and urine pits for Officers, N.C.O.'s and men.
- (b) Night accommodation.
- (c) Drains and pits for refuse and waste water.
- (d) Incinerators.

(c) LATRINES SHOULD BE—

- (a) To leeward of the camp.
- (b) Far from the kitchen.
- (c) Never drained into gullies.
- (d) Clear of the water supply.
- (e) Filled in with earth, when the refuse is within 6 inches of the ground level.

(d) The following latrines have proved to be the most serviceable :—They should always be covered from view by canvas screens.

- (a) Earth closets.
- (b) Short trenches.—Number required per day, equals 5 per cent. of the men encamped ; the following day the intervening spaces can be used.
- (c) French latrines.—40ft. square : the principle involved is, that if excreta is kept from flies and insects, nature will render it harmless in from 4 to 6 weeks.

URINAL.—Two shallow trenches draining into a cess-pit.

### HYGIENE IN THE EAST.—

It is of interest to note that systems of sanitation applicable to western countries are useless in the



East. Two great influences have to be taken into consideration :—Firstly, millions of flies and other insects; and secondly, sandstorms. Special latrines must be devised to combat these influences : excreta, etc., must be buried in pits, the sides of which have been revetted with sandbags to prevent upheaval of the loosened earth by stones. Sandbags should also be placed on the top. The following latrine and urinal has been adopted.

(a) PORTABLE LATRINE.—A long box with spring lids, to ensure that no insects will enter when not in use, the box is fitted into the ground over a hole revetted with sandbags. This box is collapsible and is folded and carried from place to place.

(b) URINAL.—Hole 12ft. deep, floored with loose stones. A drain pipe is placed in the hole and thoroughly bedded in with sandbags. The principle is, that flies will not descend into the darkness.

#### 4. HYGIENE IN THE TRENCHES.—

(a) Sweep out daily the trench, dug-out, and machine gun emplacements.

(b) Parapets and trenches should be disinfected regularly.

(c) Latrines must be below the level of the trench, to avoid the drainage of the urine into it.

(d) Tins and refuse must not be thrown over the parapet; in summer, the result is huge collections of flies.

(e) All dead should be buried as soon as possible.

(f) Excreta, etc., must be taken to the rear daily and buried or burned.

(g) The following assist in the prevention of frost-bite :—

1. Wear large boots and pad the feet with sacking or cloth.

2. Putties should always be slack.

3. Dry and rub the feet whenever possible.

4. Grease the feet with the material provided.

#### 5. LATRINE SUITABLE FOR THE TRENCHES.—

Finally, hygiene principles are familiar to most Officers; the subject is, however, very little understood or appreciated in the ranks. Lectures, therefore, to the men on this much neglected subject, should be as frequent as possible.

## SECTION II.

### A FEW HINTS ON FIRST AID.

Owing to the impossibility of receiving expert medical assistance in the actual firing line, at all times, everyone should be trained in the use of the First Field Dressing and Iodine Ampoule, issued on proceeding on active service. Wounded men will then probably receive immediate attention; and, although the treatment of their wounds may be very elementary, much may be done which will not only relieve pain, but will assist in the speedy healing of the wound, or perhaps save life. To instruct men, therefore, Officers should have a complete knowledge of—

1. The First Field Dressing and Iodine Ampoule—Parts and uses.
2. How to dress a wound.
3. Essentials in dressing wounds.
4. How to check bleeding—The circulatory system.
5. Points regarding head, chest, and stomach wounds.
6. Elementary treatment of fractures.

#### 1. FIRST FIELD DRESSING.

Directions are written on these as to procedure when wounded, but if men do not receive previous instruction they are helpless if wounded at night.

#### 2. HOW TO DRESS WOUNDS.

- (1) Cut away clothing around the wound.
- (2) Check the bleeding.
- (3) Apply iodine.
- (4) Apply dressing—on both sides of the limb if necessary.

#### 3. ESSENTIALS IN DRESSING WOUNDS.

- (1) Use the wounded man's F. F. D.
- (2) Speed, coolness, and thoroughness in what you do.
- (3) Cleanliness—avoid breathing on the wound, or touching it with soiled fingers.

#### 4. CHECKING OF BLEEDING.

A slight knowledge of the circulatory system is



essential, in order that pressure may be applied correctly when checking bleeding. The essentials are—

*The Heart*—a muscular organ—contracts and pumps pure blood into the arteries.

*The Arteries*.—They convey the bright red blood to all parts of the body, and divide and sub-divide to form the microscopic capillaries. The “pressure points” should be demonstrated.

*The Capillaries*.—Contain red blood (ordinary bleeding—*e.g.*, a cut finger); here chemical action takes place, whereby the blood gives food to the muscle tissues and collects all impurities. The capillaries join up to form veins.

*The Veins*.—Convey impure blood (dark red) back to the heart for purification in the lungs.

Bleeding is therefore arterial, capillary, or venous, and can be checked by—

- (1) Digital pressure.—Arterial, on the side nearer the heart; venous, on the side further from the heart, and on both sides when the vein is dilated or varicose.
- (2) Deflexion—*i.e.*, placing a pad in the elbow, armpit, or knee, and bending the limb.
- (3) Pad or bandage—*e.g.*, a tourniquet.

#### 5. POINTS REGARDING WOUNDS.

- (1) Head wounds.—Avoid pressure on the brain in case of fractures.
- (2) Chest wounds.—Lie still for half-an-hour; incline to injured side to drain the blood from the chest.
- (3) Stomach wounds.—Avoid all food and drink. Administer morphia if necessary—maximum dose two tablets or half a grain.

N.B.—Patients treated with morphia or tourniquets should always be labelled on the buttons of the tunic, stating the time of application of each. Tourniquets should never remain on a patient more than half-an-hour, unless it is to check the bleeding of a *stump*.

#### 6. TREATMENT OF FRACTURES.

Improvised splints should be provided, with a view to rendering the patient incapable of moving the injured limb, during his removal to the dressing station. When a rifle is used as an improvised splint for thigh, it should first be carefully unloaded.

## CHAPTER IV.

### NOTES ON FIELD WORKS.

#### SECTION 1.

##### GENERAL RULES.

1. (a) A machine gun Officer should not attempt, without expert assistance or advice, to do work which is beyond the scope of his engineering technical training.

(b) He should not rely on the Royal Engineers to do work of a technical machine gun nature, such as setting of loop-holes, height and size of platforms, etc.

2. Co-operate with the technical services. They can give much material and help which is otherwise difficult to obtain.

3. When about to be relieved, write down a list of work in progress, preferably in the form of sectional and plan drawings. These should be handed over to the incoming Section Officer with any additional notes that may be of assistance to him.

4. Even if a machine gun section is being relieved the following day, essential repair work to the portion of trenches occupied must not be postponed.

Leave the trenches occupied clean and dry, and in as good repair as possible.

5. Small repairs if taken in hand in time, both to emplacements and trenches leading to them, will always repay the trouble taken.

#### SECTION 2.

##### HINTS BASED ON RECENT EXPERIENCE.

1. There are seldom enough emplacements in any given trench system.

2. Many machine gun emplacements are disclosed by the obstacles placed in front of them, and thus destroy surprise effect.

3. Concealment from aircraft of work under construction is essential. This can most easily and effectively be done by the use of wire netting stretched above the work, and bunches of grass, sandbags, or brushwood tied on to it.



4. When chalk is being excavated from beneath surface loam, it must be removed from the neighbourhood of the work. All tracks and paths must be covered up which lead to emplacements. They will eventually disclose the position of the emplacement.

5. More time is wasted by working parties running short of material than in any other way. Always make certain before undertaking any work that the necessary material is available.

6. When possible, it is usually better to prepare woodwork used in construction, behind the line, and carry it to the site of the work ready for use.

#### DUG-OUTS.

The result of observation of the effect of direct hits from high-explosive shells or Minenwerfer projectiles on deep mined dug-outs, tends to show that if the roof is well supported, 12ft. to 14ft. of chalk or sand, and 17ft. to 20ft. of loam, will afford adequate protection against 5'9 or even 8in. shells.

The entrances of mined dug-outs are the weakest points. Aim at securing at least 6ft. of head-cover above the first frame, and see that the frames near the entrance are especially strong and braced. The trench at the entrances of the dug-out should be provided with overhead cover, and struts put in to prevent it collapsing and blocking the entrances. Always insist on at least two entrances to each dug-out.

The minimum size of a dug-out for a machine gun team should be 8ft. long, 6ft. wide, and 6ft. high. The stairs should have frames at least 4ft. 6in. high, by 3ft. wide, and be made at a slope of 1/1.

Do not attempt to make a dug-out with mined entrances, without some expert assistance. Once it has been properly started, and the direction and slope of the entrances secured, it can be continued without much further help.

Always keep a pick and shovel in every deep dug-out.

If the "Elephant" shelter is going to be used, see that the excavation for it is sufficiently deep to enable 2ft. to 3ft. of earth be put on the top, as well as a bursting layer, covered with 6in. of earth. This means that the excavation must be at least 11ft. deep. A timber framework which does not quite touch the inside of the roof of

the shelter will greatly reduce the concussion caused by a direct hit on an "Elephant" shelter.

### EMPLACEMENTS.

(1) OPEN.—Minimum size for all round traverse 4ft. by 4ft., unless recesses are made in the parapet, into which the legs of the tripod can be fitted. Height from table to top of parapet 15in. to 18in.

If the emplacement is constructed to shoot to a flank, see that the loop-hole is properly defiladed. Minimum size for a fixed line of fire 3ft. 6in. by 4ft.

Emplacements sited behind the parapets, and approached by a short trench leading from the main trench, are frequently the most effective in advanced positions. They are well concealed, and owing to the presence of infantry in front, give additional confidence to the gunners.

Ammunition-box Mounting.—Cut a hole in the lid to fit the cone, and a block fixed to the bottom of the box on which the end of the cone may rest. The box must be clamped to a 9in. or 12in. plank about 4ft. long, and the plank then built into the parapet.

(2) SPLINTER-PROOF.—About 2ft. of earth gives protection against shrapnel, fragments of high explosive shells, or bombs.

1. Always sight the loop-hole first: this will enable the depth of excavation necessary to be decided upon.

2. Excavate the required amount of earth; do not disclose its position, and remove the earth some distance away.

Make a rough section and plan of the emplacement it is proposed to construct, and calculate the amount and sizes of the material required.

A chamber 5ft. long, 4ft. wide, and 4ft. high, is the minimum. If a "Longfield" mounting is to be used, the chamber should be 6ft. wide.

The minimum size of the loop-hole is 3in. by 3in., if using a muzzle-pivot mounting; leave room above this to enable the rear-cover of the gun to be raised. The minimum for Vickers gun is 15in.

In making a loop-hole, 5ft. of earth are required to stop a bullet, and if this cannot be obtained, use  $\frac{1}{2}$ in. steel plates round the loop-hole. Defilade or conceal the loop-hole with sandbags or other material.



(3) **REINFORCED CONCRETE EMPLACEMENTS.**—Do not attempt to construct without expert assistance. Insist on a double roof separately supported, and an air space of at least one foot.

The importance of a bursting course has been abundantly demonstrated, but see that it comes well over the sides of the emplacement, and that it is not covered by more than 6in. to 9in. of earth. If there is more, it tends to act as tamping to the explosion. There should be at least 2ft. of earth between the bursting course and the roof.

### CONSOLIDATION.

Speed being of the utmost importance, concentrate your attention on isolated portions of the captured trench or position which have been least battered, and put these in a state of defence. Then see about the intervening portions.

Do not delay to put out obstacles of some sort. As soon as positions have been made from which the guns can fire, make every attempt to protect them with wire.

An emplacement can very rapidly be made in a shell-hole. Select a deep one, the sides of which are as steep as possible, and use sandbags for a platform, if available.

## SECTION 3.

### MEASUREMENTS OF EMPLACEMENTS.

These notes and diagrams have been prepared to assist Machine Gun Corps and Royal Engineer Officers in the planning of covered emplacements for the Vickers '303 light gun, mounted on various types of mountings and using fixed sights or the tangent sights.

Emplacements should be made as small as possible. For minimum dimensions see tables below.

In planning :—

1. Fix the limits of the traverse. This will determine the width of the emplacement.
2. Fix the bottom of the loophole at the lowest possible height.
3. Determine mounting to be used.

THEN CONSULT TABLES FOR DIMENSIONS.

Note.—

1. MARK IV. TRIPOD, AND MARK IV. TRIPOD AND DISAPPEARING MOUNTING.—The figures given

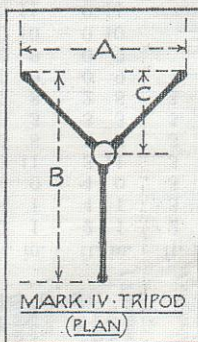
*Chapter IV, Section 2 (continued), and Section 3.*

are for a maximum traverse of  $17^{\circ}$ . For a wider traverse  $P^1$  and  $P^2$  and also WIDTH OF LOOPHOLE WOULD HAVE TO BE INCREASED.

2. "LONGFIELD" MOUNTING.—Figures given are for the MAXIMUM traverse obtainable. For a smaller traverse  $P^1$  and  $P^2$  might be REDUCED.
3. Figures 1—6 in the second column of the Table of Dimensions refer to measurements of the spread of the legs given in Table I. Six different heights of the Mark IV. Tripod can be used; 1 being the lowest position, 6 being the highest.
4. To use the tables: Decide height of tripod required. Measurements 1—6. Then turn to diagram of the emplacement to be employed, and read off the letters representing the measurements. Look these up in the Table of Dimensions opposite 1, 2, 3, 4, 5, or 6, in accordance with the height and type chosen. These will be the measurements required.
5. All similar letters on the diagrams correspond.

TABLE I.

		ft.	in.
A	1 ...	3	3
	2 ...	3	2
	3 ...	3	1
	4 ...	3	0
	5 ...	2	8
	6 ...	2	4
B	1 ...	3	9
	2 ...	3	8
	3 ...	3	7
	4 ...	3	4
	5 ...	2	11
	6 ...	2	4
C	1 ...	1	5
	2 ...	1	4
	3 ...	1	3
	4 ...	1	2
	5 ...	0	11
	6 ...	0	7



PLAN I.



TABLE OF DIMENSIONS. (To the nearest inch.)

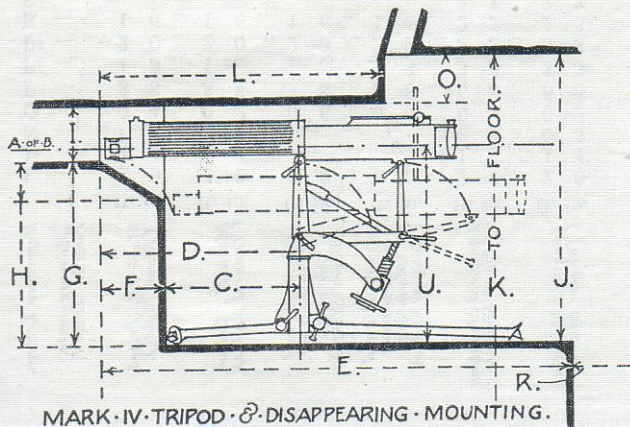
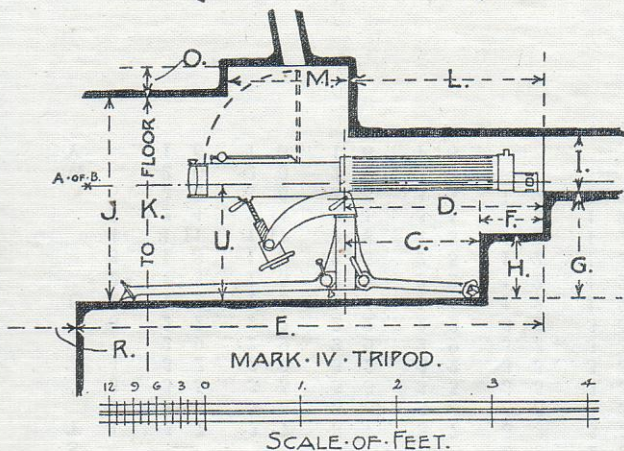
Reference Letters.	Measurements, Plan I., Table I.	Mark IV. Tripod (Fixed Sights).	Mark IV. Tripod (Tangent Sights).	Mark IV. and Disappearing Mounting (Fixed Sights).	Mark IV. and Disappearing Mounting (Tangent Sights).	Longfield Mounting (Fixed Sights).	Longfield Mounting (Tangent Sights).
		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
D	—	2 1	2 1	2 1	2 1	2 1	2 1
E	1	4 1	4 1	4 1	4 1	3 0	3 0
	2	4 0	4 0	4 0	4 0	3 0	3 0
	3	3 11	3 11	3 11	3 11	3 0	3 0
	4	3 8	3 8	3 8	3 8	3 0	3 0
	5	3 3	3 3	3 3	3 3	3 0	3 0
	6	2 8	2 8	2 8	2 8	3 0	3 0
F	1	0 9	0 9	0 9	0 9	—	—
	2	0 9	0 9	0 9	0 9	—	—
	3	0 10	0 10	0 10	0 10	—	—
	4	0 11	0 11	0 11	0 11	—	—
	5	1 3	1 3	1 3	1 3	—	—
	6	1 7	1 7	1 7	1 7	—	—
G	1	1 1	1 1	1 10	1 10	1 1	1 1
	2	1 4	1 4	2 1	2 1	1 1	1 1
	3	1 7	1 7	2 4	2 4	1 1	1 1
	4	1 10	1 10	2 7	2 7	1 1	1 1
	5	2 2	2 2	2 11	2 11	1 1	1 1
	6	2 7	2 7	3 3	3 3	1 1	1 1
H	1	0 8	0 8	0 5	0 5	—	—
	2	0 11	0 11	0 5	0 5	—	—
	3	1 2	1 2	1 2	1 2	—	—
	4	1 5	1 5	0 5	0 5	—	—
	5	1 9	1 9	0 5	0 5	—	—
	6	2 1	2 1	0 5	0 5	—	—
I	—	0 7	0 9	0 7	0 9	0 7	0 9
J	1	2 2	2 4	2 11	3 1	2 2	2 4
	2	2 5	2 7	3 2	3 4	2 5	2 7
	3	2 8	2 10	3 5	3 7	2 8	2 10
	4	2 11	3 1	3 8	3 10	2 11	3 1
	5	3 3	3 5	4 0	4 2	3 3	3 5
	6	3 7	3 9	4 4	4 6	3 7	3 9
K	—	Will depend on level of Trench.					

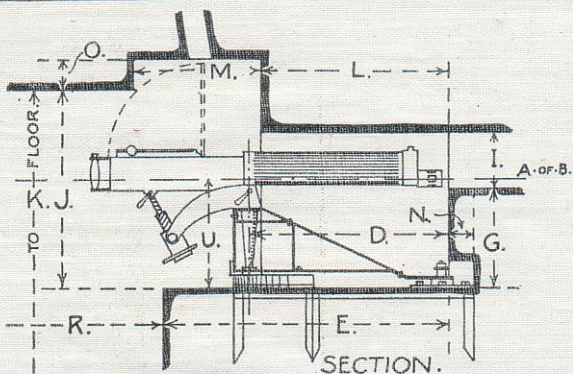
Chapter IV, Section 3 (continued).

Reference Letters.		Measurements, Plan I., Table I.		Mark IV. Tripod (Fixed Sights).		Mark IV. Tripod (Tangent Sights).		Mark IV. and Disappearing Mounting (Fixed Sights).		Mark IV. and Disappearing Mounting (Tangent Sights).		Longfield Mounting (Fixed Sights).		Longfield Mounting (Tangent Sights).	
		ft. in.		ft. in.		ft. in.		ft. in.		ft. in.		ft. in.		ft. in.	
L	—	...	2 0	...	2 0	...	3 0	...	3 0	...	2 0	...	2 0	...	2 0
M	—	...	1 4	...	1 2	...	—	...	—	...	1 4	...	1 4	...	1 4
N	—	...	—	...	—	...	—	...	—	...	0 3	...	0 3	...	0 3
O	—	...	0 4	...	0 2	...	0 6	...	0 6	...	0 4	...	0 2	...	0 2
P	—	...	3 8	...	3 8	...	3 8	...	3 8	...	6 6	...	6 6	...	6 6
P <sup>1</sup>	—	...	1 8	...	1 8	...	1 8	...	1 8	...	3 3	...	3 3	...	3 3
P <sup>2</sup>	—	...	2 0	...	2 0	...	2 0	...	2 0	...	3 3	...	3 3	...	3 3
R	—	...	1 6	...	1 6	...	1 6	...	1 6	...	2 3	...	2 3	...	2 3
S	—	...	—	...	—	...	—	...	—	...	2 3	...	2 3	...	2 3
T	1	...	3 7	...	3 7	...	3 7	...	3 7	...	3 3	...	3 3	...	3 3
	2	...	3 6	...	3 6	...	3 6	...	3 6	...	3 3	...	3 3	...	3 3
	3	...	3 5	...	3 5	...	3 5	...	3 5	...	3 3	...	3 3	...	3 3
	4	...	3 2	...	3 2	...	3 2	...	3 2	...	3 3	...	3 3	...	3 3
	5	...	2 9	...	2 9	...	2 9	...	2 9	...	3 3	...	3 3	...	3 3
	6	...	2 2	...	2 2	...	2 2	...	2 2	...	3 3	...	3 3	...	3 3
U	1	...	1 2	...	1 2	...	1 11	...	1 11	...	1 2	...	1 2	...	1 2
	2	...	1 5	...	1 5	...	2 2	...	2 2	...	1 2	...	1 2	...	1 2
	3	...	1 8	...	1 8	...	2 5	...	2 5	...	1 2	...	1 2	...	1 2
	4	...	1 11	...	1 11	...	2 8	...	2 8	...	1 2	...	1 2	...	1 2
	5	...	2 4	...	2 4	...	3 1	...	3 1	...	1 2	...	1 2	...	1 2
	6	...	2 8	...	2 8	...	3 5	...	3 5	...	1 2	...	1 2	...	1 2
W	—	...	2 0	...	2 0	...	2 0	...	2 0	...	—	...	—	...	—
Y	—	...	1 6	...	1 6	...	1 6	...	1 6	...	—	...	—	...	—

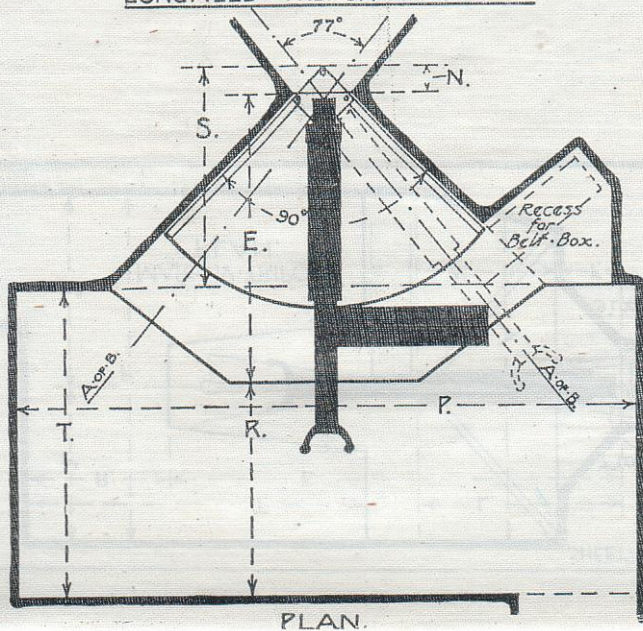


VICKERS · 303 · LIGHT · GUN.  
DIAGRAMS · SHOWING · MINIMUM  
DIMENSIONS · FOR · EMPLACEMENTS  
FOR · VARIOUS · TYPES · OF · MOUNTINGS.  
(BATTLE · SIGHTS · ONLY.)

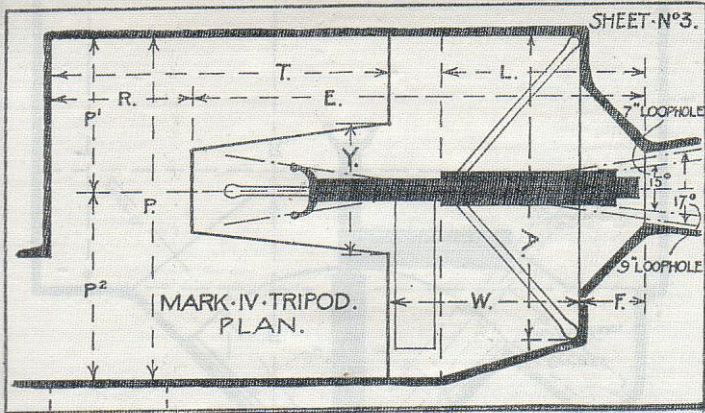




LONGFIELD · TRENCH · MOUNTING.







## CHAPTER V.

### MISCELLANEOUS.

#### SECTION 1.

#### NOTES ON RECONNAISSANCE.

The term reconnaissance includes all actions, either singly or combined, of Officers and men, undertaken for the purpose of gaining tactical information, upon which the Commander's plan of action is based.

All men should be trained in reconnoitering, observing and reporting the result of their observations.

Infantry machine gun scouts normally work on foot, though at times they may be mounted on horses or bicycles when these are available.

The value of work done by Scouts depends to a great extent on the orders they receive before they are dispatched. Each Scout must have a particular duty assigned to him.

He must observe and report, and only use his weapon in self-defence.

Rapid communication of information gained must be arranged for.

Bear in mind that the two essentials for successful handling of machine guns, are concealment and surprise. These can only be obtained from a detailed knowledge of the ground, obtained—

- (a) By going over the ground.
- (b) By study with the glasses.
- (c) Maps, aeroplane photographs, etc.

#### FROM A MAP.

- (a) General physical conformation of country.
- (b) Positions of roads, railways, farms, etc.
- (c) Obstacles, natural and artificial.
- (d) Nature of country in rear of enemy position.

#### GENERAL POINTS TO BE CONSIDERED:—

- (1) The object in view.



- (2) Factors likely to affect situation—
  - (a) Topographical.
  - (b) Relative numbers.
  - (c) Probable object of enemy
  - (d) Weather conditions.
  - (e) Ammunition.
  - (f) Supplies.
- (3) Courses open to own troops.
- (4) Courses open to enemy troops.
- (5) Proposed action.

DETAILED POINTS TO BE CONSIDERED:—

- (a) Dead ground or concealed cover.
- (b) Field of view from prone position.
- (c) How much ground is commanded from enemy position.
- (d) Selection of gun positions having best command and least exposure.
- (e) Suitable lines of advance, communication, or retirement.

RECONNAISSANCE IN TRENCH WARFARE.

POINTS TO BE CONSIDERED :—

- (1) (a) Note our particular sector, and obtain the most up-to-date map of trenches, and dispositions of infantry with whom working.
- (b) Note doubtful points not brought out in sketch or map.
- (2) Enemy Line.
  - (a) Distance from our own front line, and general position.
  - (b) Known machine gun emplacements.
  - (c) Danger points.
  - (d) Ground behind enemy line.
- (3) Position of forward guns.
- (4) Position of main line of defences.
- (5) Position of reserve guns.
- (6) Gun positions and dug-outs suitable for own scheme.
- (7) State of repair of trenches, communication, etc.
- (8) Routine in force for ration parties, etc., dumps, and roads.
- (9) Enemy practice, shelling, sniping, etc.
- (10) General scheme of defence.

*Chapter V, Section 1 (continued).*

## SECTION 2.

### GRENADE TRAINING.

GENERAL REMARKS.—To the machine gunner the grenade is primarily a weapon of defence. For the protection of his gun against hostile grenade parties, owing to the impracticability of using the rifle in a traversed trench, the machine gunner relies largely upon grenades. For this purpose two boxes of grenades should be kept in each machine gun emplacement.

TRAINING.—It is therefore essential that all machine gunners should be trained throwers, not only as regards accuracy and long distance—which is of the first importance—but each member of the team should have an intimate knowledge of the mechanism of a grenade, and of the precautions to be observed in handling it.

THROWING.—As regards the training in throwing, Officers should remember the following points:—

(a) The grenade should be bowled over-arm, and not jerked with the wrist.

(b) The “standing load” position should be assumed—i.e., half-right, facing target.

(c) Physical fitness is essential for protracted throwing, for, unless the throwing muscles are properly developed, the thrower soon tires, thereby losing distance and accuracy, often with disastrous results to the gun which he is defending.

N.B.—A competition can be introduced to develop the throwing muscles.

HANDLING.—Men should be taught the following points as regards the handling of a Mills Grenade:—

1. The lever should be placed against the base of the fingers of the throwing hand.

2. The grenade should be gripped naturally with fingers and thumb. A tight grip is to be deprecated, for the thrower is inclined to “pull” the grenade from the correct direction.

3. Pins should be withdrawn carefully—without jerking or twisting—to avoid the breaking of the pins, which are frequently made of soft metal.



PRECAUTIONS.—In detonating grenades, the following precautions are advised :—

1. Each striker should have two studs on the base.
2. The wall between the centre and detonator chambers should be without flaw.
3. The joint between the detonator and fuse should be correctly crimped and sealed with varnish, pitch, etc.
4. Screw up base plug securely with key.

PRACTICE.—It is the duty of all Section Officers to see that their men receive sufficient practice in throwing dummy grenades, so that when they are called upon to throw live grenades, their confidence in their own throwing powers counterbalances their natural fear of handling live grenades for the first time.

### SECTION 3.

#### NOTES ON SIGNALLING.

1. The Company Commander is responsible for all inter-communication within his own Company. If any difficulties occur owing to lack of equipment or men, he should apply to the Brigade Signalling Officer for assistance.

2. Basis of communication :—

(a) Do not employ visual for long messages over short distances, unless ground be swept by fire.

(b) Ensure all stations keep alert, and in using the telephone, one man must have receiver strapped to his head.

(c) Move stations as seldom as possible.

(d) Signallers must not be sent on orderly duty. These orderlies must be obtained from other sources.

3. DISPOSAL OF THE SIGNALLING EQUIPMENT OF A MACHINE GUN COMPANY IN THE FIELD (applicable to a Corporal and three men).

FOUR MESSAGE BOOK CASES in satchel form. Each man should have one slung over his shoulder when on duty. It should contain A.F. 2121 and 2123, carbon duplicating paper and pencils, originals of sent and received messages.

*Chapter V, Section 2 (continued), and Section 3.*

**SIXTEEN FLAGS.** (8 blue, 8 white with blue stripe). Each man will carry a blue and a white for use, 8 spares to be carried in limbered wagon as spare.

**TWENTY FLAG POLES.** 16 will have flags affixed, 4 spare in wagon.

**SIXTEEN CELLS, ELECTRIC, INERT.** 8 are either in the D 3 Telephone, or to be at once placed there, remainder spare in wagon.

**FOUR TELEPHONES PORTABLE D., MARK III.** During transit by a cycle, invariably on back of the man. Preparatory to use, slung on shoulder of the man. During use, in a clean dry position. An Officer should be detailed to inspect cleanliness of instruments with particular attention to top of cell terminals and crystalization.

**EIGHT REELS, CABLE NO. 1.** During transit, four invariably on front carrier of cycle, with cable wound, and carrying bars fixed, remaining four with cable wound, spare in limbered wagon.

**FOUR BARS FOR REEL CARRYING.** Will be with reels in, or ready for use.

**FOUR MILES CABLE, ELECTRIC, D 1.** (in  $\frac{1}{2}$  mile reels). Wound on reels ready for use. (*Vide reels*).

**FIVE YARDS WIRE, ELECTRIC, D 2.** For utilising as Earth Pin connections.

**FOUR EARTH PINS.** Invariably carried on the man (one each).

**ONE LAMP, ELECTRIC, FIELD, IN LEATHER CASE.** Kept ready and in good repair in wagon, at a position, or Station nearest to anticipated position for its use.

**DISC SIGNALLING, Mark II.**—Carried in wagon ready for issue when nearing the front line, or position where likely to be of utility.

**STAND LAMP** (also of use with helio if available), always to be kept with lamp.

**TWO COMPASSES, PRISMATIC.**—One for Corporal, the other for distribution, at his discretion, to man i/c Station.

**TWO WATCHES.**—One for the Corporal, or men possessing the least reliable timepieces.



FOUR TELESCOPES AND STANDS.—Carried one in each No. 2 Limber. For distribution to men as occasion requires.

PLIERS (Side-cutting, 5in.), PAIRS.—Each man should be in possession of a pair.

FOUR CYCLES, WITH CARRIERS.—For use at discretion of O. C. Company, whether for use of Signallers or Orderly Duties. (In the latter case, should be ridden by men other than Signallers, and be stripped of any equipment.) The front carrier of cycle will be utilised for cable, and the back carrier for the man's pack, when the man is carrying the telephone on his back.

TWO TELEPHONE MICROPHONE CAPSULES.

ONE POUND TAPE, ADHESIVE ; ONE YARD OF RUBBER TUBING,  $\frac{3}{8}$ in.—These should be stored under the direction of the Corporal, and handy to telephone, whether in use or not.

#### 4. A GUIDE TO USE OF INSTRUMENTS :—

FLAGS, 3 to 7 miles (the latter with telescope), average conditions.

LAMP, 8 to 10 miles.

DISPATCH RIDING—

Motor Cycles... 20 miles per hour.

Cycles ... 8 „ „

Horse ... 6 „ „

Also usual maximum for use in relay work.

The average speed for Instruments is 40 alphabetical letters per minute. In disc work it is reduced to 20.

5. As only four signallers are posted to each company, the O. C.'s discretion must be used in sending these men to maintain communication between various sections and himself. He cannot expect to be in direct communication with every section. Section Officers with guns in front line should apply to Infantry Commanders to obtain permission to use, as far as possible, the lines of the Infantry Company in whose section of the line they are posted. If necessary, a direct line can be laid *from Machine Gun Company Headquarters to Battalion Headquarters.*

*Chapter V, Section 3 (continued).*

6. ORDER OF PRECEDENCE of messages on Signal Service Lines :—

- (1) Urgent service, affecting working of line.
- (2) O.H.M.S., priority.
- (3) Service message, working of the line.
- (4) O.H.M.S., not priority.

7. OUTGOING MESSAGES SHOULD BE WRITTEN ON A. F. 2121 (white), and signed in space "Z." The addressor should wait until the signaller has read and thoroughly understood the message. A signaller is allowed to suggest alterations in a message, which will decrease the number of words without altering the sense of the message. Messages of undue length should be avoided ; all original copies of messages should be kept for checking and reference. If a verbal message is given, it should allow of the Signaller writing it down, and should then be read over and signed. Officers only should be allowed to use the speaking circuit of the Telephone.

The preamble and all spaces above the "Address To," with the exception of the space for franking, is reserved for use of Signaller. All important words should be in block capitals, and important numbers in words.

INCOMING MESSAGES.—Messages received should be written on A. F. 2123 (pink), which has one page for original and one for duplicate copy. The duplicate copy is sent out to addressee and the original retained by Signaller.

A Signaller cannot be expected to deliver messages, as this would mean leaving his station, and holding up further work until his return.

The Officer in charge should notify the Signaller where he can be found in the event of an *important message being received*. When all signallers are employed, the cycles may be handed over to spare men, if any, who act as orderlies. These can be utilised for sending batches of returns to BRIGADE HEADQUARTERS, etc. On any change of position a cyclist should be sent to find the nearest way to BRIGADE HEADQUARTERS, and instructed to direct one man from BRIGADE HEADQUARTERS to his HEADQUARTERS. This will facilitate the sending of messages by orderly.



## SECTION 4.

### INSTRUCTIONS ON THE COLLECTION AND TRANSMISSION OF INTELLIGENCE BY TROOPS.

1. Early and complete information regarding any of the enemy's units, with which our troops may be engaged, is required at all times by the Intelligence Section at General Headquarters Home Forces (*on the continent*, General Headquarters of the Expeditionary Force concerned).

2. Such information is obtained by contact with the enemy and by searching the enemy's dead, wounded, prisoners, and deserters. It should be forwarded through the usual channels.

3. The identification marks to be looked for on German soldiers are the following:—

- (a) The identity disc. (hung round the neck).
- (b) The pay book (*soldbuch*)—in the tunic pocket and the tail pocket of the tunic.
- (c) The shoulder strap. (This is marked with a number or monogram, but these are often covered up with some material. The nature and colour of these marks, as well as that of the surrounding piping, should be noted. Should it be forwarded, state whether taken from the tunic or from the greatcoat).
- (d) Markings found on arms, clothing, &c. :—
  - (i.) Inside the flap of the cartridge pouch.
  - (ii.) On the bayonet near the hilt.
  - (iii.) On the back of the tunic lining.
  - (iv.) Inside the cap or helmet.
- (e) The colour of pipings, bands, &c., on :—
  - (i.) Caps (the band is often covered over by a strip of grey cloth);
  - (ii.) Tunics (collar and cuffs).
- (f) Maps, letters, orders, notebooks, &c. (usually found in the skirt pocket at the back of the tunic).

One or two shoulder straps may be cut off and sent on with the documents.

#### 4. *Procedure in the case of the enemy's dead.*

All identity discs, papers, and pay books found on the dead are to be forwarded to Brigade Headquarters together with a statement as to the place where they were found, and with a concise note as to the peculiarities of uniform.

#### 5. *Procedure in the case of prisoners.*

- (a) Prisoners are to be searched at the earliest opportunity after capture, in order to prevent them destroying any letters or orders, which may be in their possession.
- (b) After being searched, prisoners will be sent to Brigade Headquarters with the least possible delay (they should not be interrogated beforehand).
- (c) Lightly wounded prisoners, fit to be interrogated, will accompany those unwounded.
- (d) Identity discs will be retained by all prisoners, but papers and pay books found on them will be transmitted to Headquarters together with, but separately from, their owners.
- (e) If any prisoners are not fit to be interrogated, a statement as to their unit and the place of capture will be sent to Brigade Headquarters, together with the papers found upon them.

6. The fuzes of exploded shells furnish valuable information. When found, they should be sent to the nearest battery together with an accurate statement as to the spot where found.

7. All billets and bivouacs deserted by the enemy are to be examined for identification marks. Chalk marks on doors of billets must be copied.

8. Captured or abandoned vehicles or horses should be examined for markings.

NOTE.—Troops must be prevented from removing prisoners' shoulder straps, buttons, and identity discs with a view to their retention as "souvenirs."



## CONFIDENTIAL.

### SECTION 5. GAS DEFENCE.

All arms at the front are now issued with one small box-respirator (made in 3 sizes), one P.H. Helmet, and one pair of Sponge Goggles.

"WIND DANGEROUS." Will be ordered when the wind is in the dangerous quarter, no matter what the strength of the wind.

BEHAVIOUR DURING "WIND DANGEROUS."

1. All Box-Respirators and Helmets will be carefully inspected.

#### BOX-RESPIRATOR.

- (a) Facepiece, goggles, noseclip, and elastic in good order.
- (b) Facepiece firmly attached to the mouthpiece.
- (c) Rubber tube intact, and firmly attached to box and mouthpiece.
- (d) Test valves.
- (e) Box not damaged.

#### HELMETS.

(a) Mouthpiece horizontal, valve vertical, and securely fastened to the metal. Test valve. It should be impossible to breathe *in* through the valve.

(b) Eye pieces ; glasses intact, tightly held by screw washers, which must not be cross threaded.

(c) Fabric : no holes. Particular attention being paid to material round fittings and seams.

2. All ranks will carry the box-respirator (or helmet) "in the alert position."—*i.e.*, box-respirator worn on chest, press buttons to the body, the flap unfastened, or helmet pinned through container to shirt and folded in such a way as to protect the valve, and leave the helmet ready to put on, the moment the tunic is opened.

Nothing to interfere with the *rapid adjustment* of the box-respirator (or helmet).

3. Sentries will be posted over :—

- (a) All working parties—*e.g.*, men in mine-shafts.
- (b) Each gong and "Strombos" horn.
- (c) Every dug-out.
- (d) Each Headquarters, Signal Office, and Artillery

### Observation Post.

At night, sentries must have at least two men within reach to spread the alarm quickly. Men are not allowed to sleep in dug-outs, within 300 yards of enemy trenches, during the "wind dangerous."

### SIGNS OF A GAS ATTACK.

(a) Clanking of metal, hissing of gas, heard by sentries.

(b) Appearance of cloud over enemy trenches, which may vary in colour.

1. According to weather—dry day, greenish in colour,—damp day, a white mist.

2. On account of admixture of smoke of any colour.

(c) Smell of gas in listening posts.

### GAS ALARM.

In the event of a gas attack, the alarm will be spread by all means available—*e.g.*, telephone, gongs, "Strombos" horns, and orderlies. All ranks put on box-respirators (or helmets) and stand to arms. Troops man parapets and open *slow* fire. All movements must be reduced to a minimum. Dug-outs protected: the blanket doorway will be let down and carefully fixed.

### PRECAUTIONS DURING GAS ATTACK.

(a) Respirator masks and helmets must not be removed for giving orders.

(b) Prevent wounded men from removing helmet or respirator.

(c) So soon as respirator (or helmets) become spent or damaged, men must change into reserve helmet under cover in a dug-out fitted with anti-gas blanket protection.

If attack is unaccompanied by an infantry attack, the message "Gas Attack, Trench——" is sent.

If an infantry attack develops, the normal procedure of "S.O.S." is carried out.

### ACTION AFTER ENEMY GAS ATTACK.

Box-Respirators (or helmets) will not be removed until permission has been given by Company Commander. So as to be ready for a subsequent gas attack, all ranks will, when permission has been given to take off box-respirators (or helmets), at once adjust them in the "gas alert" position.



Clearing of dug-outs :—Unprotected dug-outs must not be entered for 4 hours after the cloud has passed, and must be ventilated freely by fires or anti-gas fans. This is the only sure method of clearing dug-outs. If unprotected dug-outs have to be entered owing to heavy shelling, box-respirators or helmets must be worn.

#### CLEANING OF ARMS.

Rifles and machine guns must be cleaned after a gas attack. Oil cleaning will prevent corrosion for 12 hours, but the first opportunity must be taken to clean all parts in boiling water, containing a little soda.

#### ACTION DURING A GAS SHELL BOMBARDMENT.

Box-Respirators will be worn in area shelled. A "Local" alarm only will be given. Men in dug-outs and shelters in the vicinity must be roused.

#### TREATMENT OF SHELL HOLES.

- (a) Fill up with fresh earth.
- (b) Light brushwood fires in them.

#### TREATMENT OF MEN AFFECTED BY GAS.

- (a) Fresh air, loosen equipment, and clothing round throat and chest, but the man *must be kept warm*.
- (b) Keep man lying down, and allow him to sleep if possible.
- (c) Raise feet above level of his head, to help him expel fluid formed on chest.
- (d) Ammonia capsules are issued for inhaling. They act, not on the gas, but as a stimulant on the heart.
- (e) Emetic only used in first stages—tablespoonful of salt, with  $\frac{1}{2}$  pint of water.

#### MACHINE GUNS IN GAS ATTACK.

In case of a gas attack, the lid of the belt box should be closed, the machine gun covered with a waterproof sheet, the lock should be hung, and the recoiling portions worked backwards and forwards; otherwise, the mechanism gets clogged from the effect of the gas, and the belt will not work properly in the feed block. If there is any target to fire at, the gun should be kept in action, as it disperses the gas round the gun.

## SECTION 6.

### BILLETING.

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#### A

Arrangements for going into billets when Company is all together in one area :—

#### 1. STAFF-CAPTAIN OF THE BRIGADE.

I. Staff-Captain usually goes forward with one Officer per Battalion, and one Officer from the M.G. Coy., and the C.Q.M.S. of each Infantry Company and the M.G. Company.

II. He will show each Officer his particular area, and leave him to make his own arrangements.

#### 2. SECOND IN COMMAND OF M.G. COY.

I. When the M.G. Coy. appears, the Second in Command (or whichever Officer accompanied the Staff-Captain) will show the M.G.C.C. the place he has appointed for parking, picketing, etc., and the M.G. Coy. is formed up in that place, under the supervision of the Second in Command, who—

II. Details the Sanitary Squad where to dig latrines.

III. Supervises the watering of the horses.

IV. Arranges for cooks' cart, and where cooking is to be carried out.

#### 3. ORDERLY OFFICER.

I. The Orderly Officer should assist the Second in Command in his duties.

II. Visit horse lines, picquets, and billets at least once during the night.

#### 4. COMPANY Q.M.S.

I. The C.Q.M.S. shows Section Officers where the men are to be billeted, and where latrines are, and where water is to be found.

II. Goes to Brigade Q.M.S. to enquire the place where rations are to be drawn—*i.e.*, refilling point—and lets Transport Sergeant know place on return to M.G. Company.

III. Pay, clothing and equipment, and ammunition.

IV. Billeting vouchers and other papers for M.G.C.C.'s signature.



5. SECTION OFFICERS.

I. Settle their men in billets, give out orders *re* latrines, drawing water, and filling water bottles, smoking, etc. Inspection of feet, socks, and boots.

II. Have guns, spare parts, and ammunition overhauled, and range-finders tested.

III. Examine their horses.

IV. Supervise all issues of rations and clothing.

6. COMPANY SERGEANT-MAJOR.

I. The C.S.M. parades Section Orderly N.C.O.'s and collects reports.

II. Parades sick and men for Company Orders.

III. Details a picquet over horses (one N.C.O. and three men), and a picquet (one N.C.O. and three men) over billets from the Section on duty.

IV. Details a ration party (which stands by till the C.Q.M.S. comes back to show them where to draw rations).

V. Gets papers ready for Company Orders.

7. TRANSPORT SERGEANT.

I. Arranges to get up forage from refilling point, and generally assists in care of horses, mules, and wagons, and discipline in the horse lines.

8. M.G.C.C.

I. The M.G.C.C. supervises the whole organization.

II. Details an Officer to go to Brigade Headquarters for orders (if Officer so detailed is the Second in Command, the Orderly Officer must take over the Second in Command's duties); this Officer can also notify Brigade as to M.G.C. Headquarters.

III. Holds Company Orders as soon as possible.

IV. Enters up War Diary.

V. Reports sick horses to Brigade Headquarters.

B

In case of a Company being rather scattered, Section Commanders make their own arrangements—(1) *re* watering horses, latrines, billeting, etc., to conform with Brigade arrangements; (2) Have men for Company Orders marched to Company Headquarters; (3) Arrange for a ration party to be told off and ready.

C

In the event of the M.G. Coy. being ordered to furnish guns with the outpost line, the O.C. Section, or Sections, ordered out should (1) tell the sub-section Officer or

Officers where to meet him with the section or sections ; (2) should ride on with his orderly, and (if still light) a range-finder on a bicycle, and reconnoitre ; (3) make himself acquainted with the dispositions of the neighbouring Infantry Company Commanders and co-operate with them ; (4) send his orderly to lead up the party and carry on with his dispositions ; (5) furnish a report and a rough sketch to his M.G.C.C. (who should forward a copy to Brigade Headquarters) ; (6) give out orders—fires, latrines, smoking, etc., etc.

D

M.G.C.C. should also have a definite system for bivouacing—*e.g.*, arrangements for sleeping under wagons, etc.

E

On leaving, Section Officers will inspect the billets of their sections to see that they are scrupulously clean, and report to the M.G.C.C. that they have done so before the Company is marched off.

Payments for billets are usually arranged through the Brigade.

Should the Company be detached, information as to the procedure for payment must be sought from Brigade Headquarters prior to departure.

## SECTION 7.

### CONTENTS OF SPARE PARTS BOX.

Blocks, jamming, with screw and handle, tripod mounting, Mark IV. (a)	1 (a)
Boxes, tin, for small parts	... 2
Bushes, axis, side levers	... 1
Case, First Aid	1 (b)
Collar, roller	... 1
Corks	... 1
Cups, muzzle attachment	... 3
Discs, „ „	... 5
Eyelets, long	$\frac{1}{2}$ oz.
Flannelette, $5\frac{1}{2}$ yards	... (c)
Fusees, with chains	... 1
Gibs	... 1
Hammer	... 1
Lever, extractor, left	... 1
„ „ right	... 1
Linen, old sheeting, for cleaning	lbs. 1 (c)

*Chapter V, Section 6 (continued), and Section 7*



Packing, asbestos, 5 yards (pieces)	...	2
Pins, axis, trigger	...	1
"    "    tumbler	...	1
"    firing	...	1
"    fixing, crank handle	...	2
"    split, fixing collar roller	...	2
"    "    keeper, bush axis, side levers	...	1
"    "    "    check nuts, long	...	4
Plugs, belt	1 (d)	
"    cork, complete	1 (c)	
"    screwed	...	1
"    front cover catch	...	2
Plunger, front cover catch	...	2
Roller	...	1
Screws, clamping, cup, muzzle attachment	...	3
Screwdriver, large	...	1
Sights, luminous, back and fore (each)	1 (c)	
Sight, fore	...	1
"    tangent	...	1
Spanner, shifting	...	1
Spring, bottom pawl	...	1
"    cover lock	...	2
Spring, front cover catch	...	2
"    fusee, with fittings	...	1
"    gib	...	1
"    lock	...	3
"    safety catch with piston	...	2
"    sear	...	2
"    sliding shutter catch	...	2
"    tangent sight	...	2
"    "    "    slide	...	2
"    top pawl	...	1
"    trigger bar	...	2
Stripes, long	...	25
"    short	...	25
Tool, repairing belt	...	1
Pins, keeper split, $\frac{1}{8}$ in. by $2\frac{1}{4}$ in.	...	6

(a) In one box only in No. 1 limber of each Section.

(b) For contents, see First Aid Case.

(c) Issued and indented for separately.

Not part of the contents of Spare Parts Box as issued.

(d) One in one box only in each limber.

*Note* :—In Action, the Spare Parts Box remains with limber or Section Headquarters in the trenches.

*Chapter V, Section 7 (continued).*

## SECTION 8. CONTENTS OF FIRST AID CASE.

Balance, spring	...	1
Block, feed	...	1
Can, oil	...	1
Funnel	...	1
Level, spirit, Mark I.	...	1
Lock	...	1
Pliers, cutting (pair)	...	1
Plug, clearing	...	1
Wallet		1 (a)

(a) For contents, see wallet.

*Note.*—The First Aid Case is carried in Action by No. 2.

## SECTION 9. LIST OF ARTICLES CARRIED IN WALLET.

Bushes, axis side levers	...	1
Cork	...	1
Discs	...	1
Fusees with chains	...	1
Gibs	...	1
Pins, axis, trigger	...	1
,,   ,,   tumbler	...	1
,,   firing	...	1
,,   split, keeper, bush axis, side levers	...	1
,,   T, fixing rear-crosspiece	...	1
Protector, muzzle	...	1
Pullthrough, double	...	1
Punch, No. 3	...	1
,,   ,,   5	...	1
Reflector, mirror, '303 inch. M.G.	...	1
Screwdriver, small	...	1
Sear, with spring	...	1
Spring, gib	...	1
,,   lock	...	1
Tool, combination	...	1
Trigger	...	1
Tumbler	...	1
Washers, adjusting, No. 1, '003 inch.	...	3
,,   ,,   ,,   2, '005 inch.	...	3
Wire Gauze, pieces	...	2

*Note.*—The Wallet is carried in Action by No. 2  
in the first aid case.



## SECTION 10.

APPROXIMATE WEIGHTS OF VARIOUS  
ARTICLES CARRIED BY A M. G. COMPANY.

<i>Description of Article.</i>	<i>lbs.</i>	<i>ozs.</i>
Axes, felling, curved helve	3	8
,, hammer-headed	2	10
,, hand, Mark II.	2	4
,, pick, heads	4	8
,, ,, helves, 36in. ferruled	1	6
Bags, line gear	1	0
,, trench, machine gun	5	4
,, tools and materials, shoemakers, filled	25	—
,, sand, common, 20 bags	8	—
Bar, supporting pole, No. 3	10	10
Bars, carrying reels, Cable No. 1	2	3
Boxes, candles F.S. (filled)	1	7
,, stationery (field)	56	0
Buckets, water, canvas, G.S.	1	0
Balances, spring, (100 lbs.), or 80 lbs.	13	—
Blankets, s.s. (or g.s.)	4	10
Crowbars, 3ft. 6in.	18	8
Crosshead, complete	17	8
Cans, lubricating, No. 9	—	11
,, half-pint	—	8
Cases, No. 1 (or No. 2), infantry, R.F.	13	—
,, spare parts (alone)	13	12
Case, first aid (alone)	—	—
Cases, spare parts, and first aid case combined	21	7
Condensers, steam	2	6
Drums, oil, 3 gallons	39	8
Files, regular cut, hand safe edge, tanged, 12in.	—	10
Funnels, tin, $\frac{1}{4}$ pint	—	3
Hooks, bill	2	3
,, reaping, large	1	1
Hammers, fitters	2	2
Holdalls, tool, saddlers, filled	14	1
Jacks, lifting, G.S.	33	8
Kettles, camp oval, 12 quarts	9	6
Knives, laboratory	—	3

<i>Description of Article.</i>			<i>lbs.</i>	<i>ozs.</i>
Lanterns, tent, folding	...	...	4	4
Lamps, brazing, 1 pint	...	...	2	4
Mallets, heel peg	...	...	2	12
Machines, mincing, tinned, iron	...	...	13	—
Machines, filling, belts	...	...	42	—
Nets, hay	...	...	—	8
Nail, pullers	...	...	4	2
Oil, lubricating	...	...	52	—
Pads, surcingle	...	...	—	4
Pegs, picketing, with rope, loop, Mark II.	...	...	1	3
Pins, picketing	...	...	2	7
Poles, draught, No. 18	...	...	51	—
Pistol, signal, 1½ in.	...	...	7	14
Ropes, head hemp with ring, Mark II.	...	...	2	5
„ heel, Mark IV.	...	...	2	5
„ picketing, 4ft. 9in.	...	...	2	5
Shovels, G.S.	...	...	3	10
Saws, folding, complete	...	...	1	13
Screwdrivers, G.S., 9in.	...	...	—	14
Soap, yellow	...	...	1	4
Stretchers, ambulance	...	...	28	—
Stands, signalling, telescope	...	...	3	12
Box, spare parts complete	...	...	22	—
Saddles, file, middling	...	...	—	2
Telescopes, signalling	...	...	3	8



## SECTION 11.

### INSTRUCTIONS FOR WATER-PROOFING WEB AMMUNITION BELTS.

1. Thoroughly dry the belt to be treated.
  2. Dissolve  $1\frac{1}{2}$  lbs. of paraffin wax in  $\frac{1}{2}$  pint of naphtha, while hot. This quantity is sufficient to do 3 or 4 belts.
  3. Soak the belt in the solution for  $\frac{1}{2}$  an hour.
  4. Squeeze the solution well out of the belt, and put the belt out to dry, until no smell of naphtha remains.
  5. If the weather is too bad for outside drying, it may be dried inside at a temperature of not more than 100 degrees Fahrenheit.
- 

## SECTION 12.

### CLEANING, OILS, Etc.

GENERAL CLEANING.—Use equal parts of G.S. lubricating oil and paraffin.

CLOGGED PARTS.—Use spirits of turpentine.

AFTER CLEANING.—Thorough dry, then lightly oil with G.S. lubricating oil.

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## SECTION 13.

### FROSTY WEATHER.

- (a) Wrap a blanket round the barrel casing.
- (b) Keep working parts of gun only very slightly oiled.
- (c) Have only 5 pints of water in barrel casing.
- (d) 20 to 50 per cent. of glycerine or alcohol, mixed with water, will prevent it from freezing so quickly.
- (e) It may sometimes be useful to keep both locks wrapped in dry rag in a man's pocket.

*Chapter V, Sections 11, 12 and 13.*

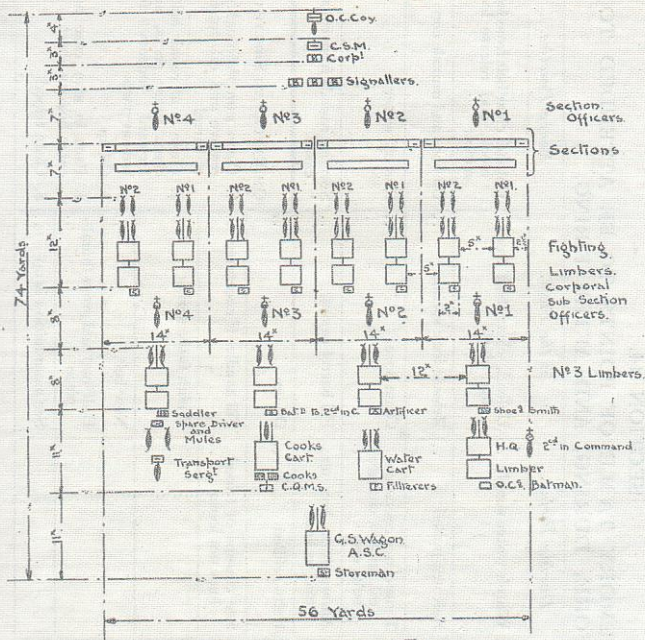
# SECTION 14.

## ABBREVIATED MEMORY TABLE OF POINTS TO BE ATTENDED TO BEFORE, DURING, AND AFTER FIRING.

<i>Before Firing.</i>	<i>During Firing.</i>	<i>In the Field.</i>	<i>Range Practice.</i>
1. Oil up. ..	Watch water supply ..	Unload, clear belt from feed block	Unload, clear belt from feed block, and release lock spring
2. Muzzle cup to be correctly fitted ..	Belt not pulled ..	Release lock spring ..	Oil bore and muzzle cup
3. Test recoiling portions ..	Temporary cessation, oil up and change belt, etc. ..	Clean bore ..	Run off water
4. Weigh fusee spring ..	Ammunition box up and in line ..	Fill barrel casing ..	Sort live rounds from empty cases
5. Examine barrel, spare parts, etc. ..	Belts refilled ..	Oil up ..	<b>ON RETURN TO SHELTER—</b> 1. Clean gun thoroughly; remove and oil outside of barrel 2. Clean and repair belts, check spare parts, and forward indents for broken parts 3. Oil up 4. Pack in gun case and enter history sheet 5. Clean tripod
6. See to water supply ..	See clamps of tripod legs not loose ..	Fill handles if necessary ..	
7. Oil in handles, etc. ..		Weigh fusee spring ..	
8. Examine belts ..		New belt ..	
9. Action to be taken in very cold weather ..		Half load and press thumb-piece ..	
10. Examine tripod ..		See ammunition is up ..	



# M.G.C<sup>oy</sup> DRAWN UP FOR INSPECTION.



## DETAIL OF SECTION IN FOURS.

Sub Section. Sub Section.  
Sergt - 4 3 2 1 4 3 2 1 4 3 2 1 4 3 2 1 - Sergt

6 5 5 6 5 R B 6 5 5 6 5 R B

S = Scout  
B = Balman.  
R = Rangefaker

## DETAIL OF SECTION IN THREES

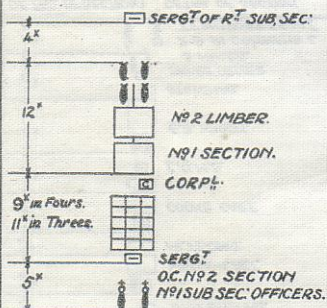
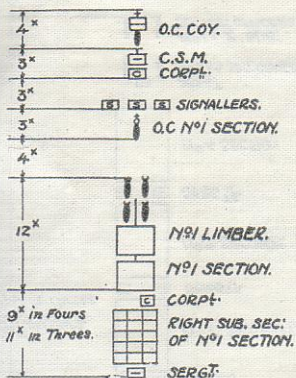
Sub Section. Sub Section.  
Sergt - R B 3 2 1 3 2 1 R B 3 2 1 3 2 1 - Sergt

5 6 5 4 6 5 4 5 6 5 4 6 5 4

A  
117

# M.G.C<sup>COY.</sup> IN COLUMN OF ROUTE.

WHEN FIGHTING IS IMMINENT.



FOLLOWED IN SUCCESSION BY N<sup>O</sup>2, 3 & 4 SECTIONS IN SAME FORMATION AT 4 YARDS INTERVALS.

THE REMAINDER OF COLUMN AS WHEN FIGHTING IS NOT IMMINENT.

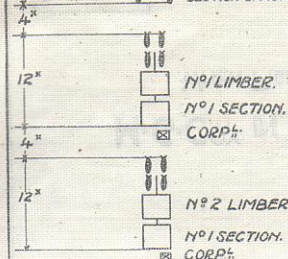
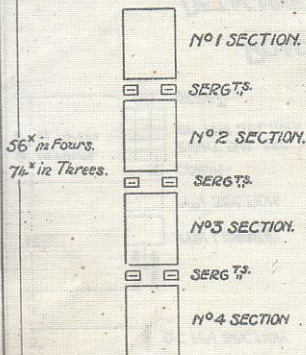
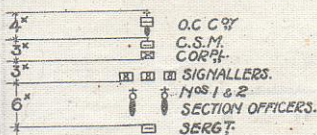
## ROAD SPACE

DETACHMENT IN FOURS 326 Yds.  
 " " " THREES 343 Yds.

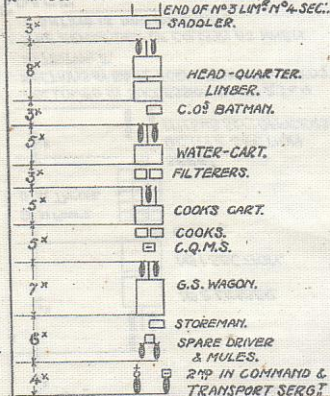
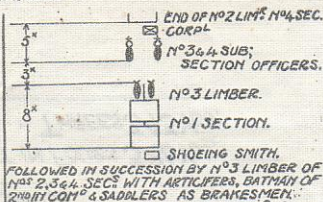


# M.G.C<sup>Y</sup> IN COLUMN OF ROUTE.

## FIGHTING NOT IMMINENT



FOLLOWED IN SUCCESSION BY Nos 1 & 2 LIMBERS  
Nos 2, 3 & 4 SECTIONS AT 4-YDS DISTANCE.  
M.G.C. STUDIO.



### DETAIL OF SECTION IN THREES

SERG<sup>T</sup>.

3	2	1
6	5	4
3	2	1
6	5	4
5	R	B
3	2	1
6	5	4
3	2	1
6	5	4
5	R	B

SERG<sup>T</sup>.

### DETAIL OF SECTION IN FOURS

SERG<sup>T</sup>.

1	2	3	R
3	4	5	6
1	2	3	5
3	4	5	6
1	2	3	R
3	4	5	6
1	2	3	5
3	4	5	6

SERG<sup>T</sup>.

### ROAD SPACE

B. BATMAN  
R. RANGE TAKER.  
3. SCOUT.

DETACHMENT IN FOURS 306'  
" " " THREES 324'

LEAD PENCIL ONLY, NO INDELIBLE.



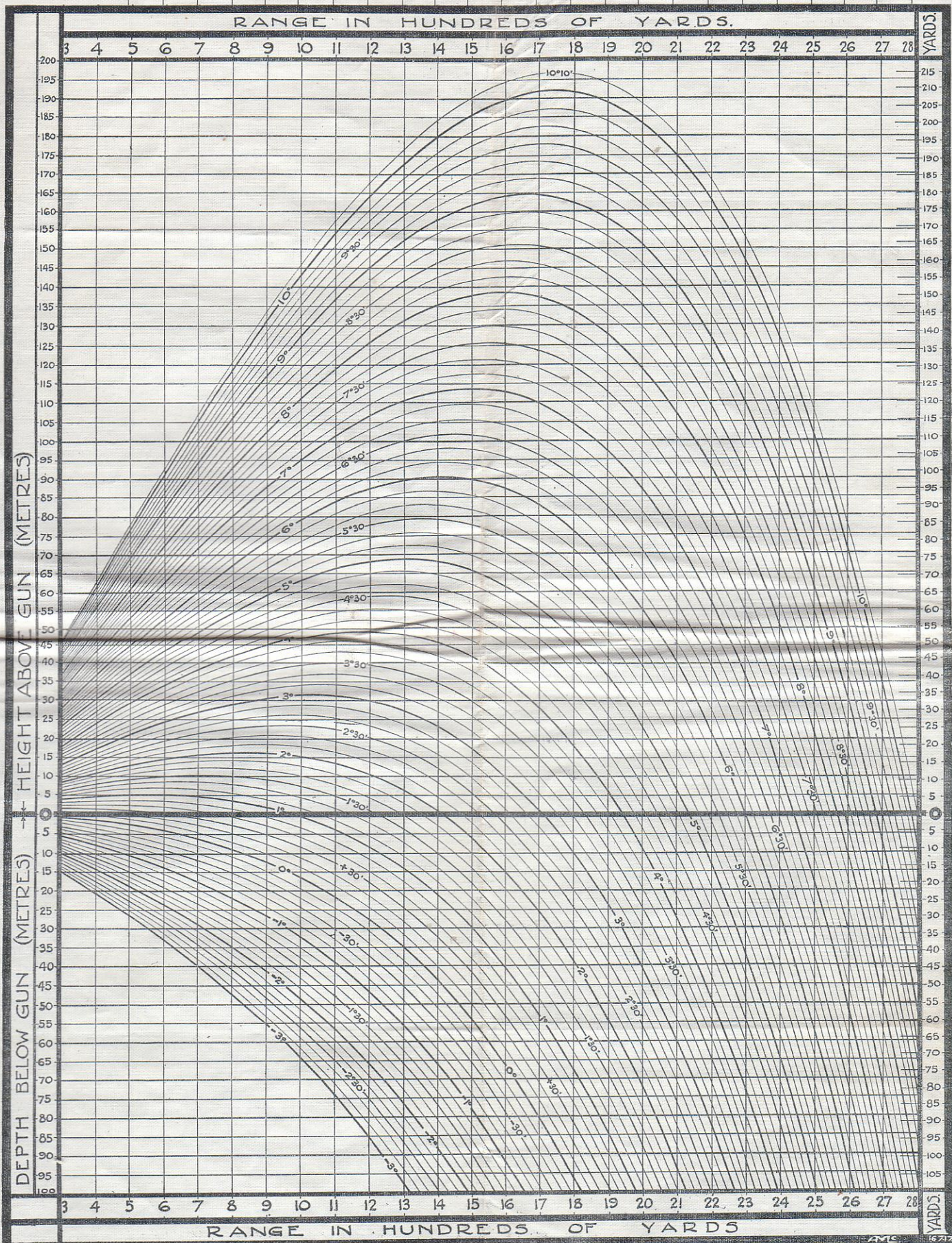
# GRAPH FOR CALCULATING QUADRANT ELEVATION AND CLEARANCES.

(CURVES REPRESENT CENTRE SHOTS.)

DEPTH OF LOWEST SHOT BELOW CENTRE OF CONE AT VARIOUS DISTANCES FROM GUN.

IN YARDS	17	20	23	27	30	33	40	47	53	60	67	73	80	87	93	10	133	167	20	25	30	35	42	48
IN METRES	16	18	21	25	27	30	37	43	48	55	61	67	73	80	85	91	122	153	183	23	27	32	38	44

RANGE IN HUNDREDS OF YARDS.



10	10	10	10	12	14	16	18	21	25	28	32	37	42	48	55	63	73	CLEARANCE IN METRES				
11	11	11	11	13	15	17	20	23	27	31	35	40	46	53	60	69	80	CLEARANCE IN YARDS				
MINIMUM CLEARANCES REQUIRED AT VARIOUS DISTANCES FROM GUN.																						

HOW TO USE THE GRAPH.—TO FIND Q.E.: Take range and run up on vertical scale to height of target above or below gun. The curve cutting this point gives required Quadrant Elevation.

TO FIND CLEARANCE.—Follow this curve along, and ascertain at what height it passes vertically above a point plotted to show distance and height (above or below gun) of own troops (or obstruction). This gives clearance in yards (right hand scale) or metres (left hand scale) from centre shot to ground.





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